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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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NOTES AND COMMENTS.

Small Steel Castings.

We were much interested by a remark made by Engineer Vice-Admiral Sir George Goodwin at the recent meeting of foundrymen, in Birmingham, a full report of which is given elsewhere, in which he stated that cast iron was better than some steel he had seen. We presume that Sir George was referring to steel castings, as we doubt if there are real grounds for complaint as to the quality of forged and rolled material. A similar complaint about the quality of steel castings was recently made before the Institution of Automobile Engineers, and probably if an investigation was made, it would be found that the serious trouble centres round the manufacture of the smaller variety of work. An examination of the subjects mentioned by the British Cast Iron Research Association as being worthy of research will convince the reader that a fair proportion is just as interesting for the steel castings manufacturer as for the ironfounder. Prof. Desch pointed out that cast iron can be looked upon as an impure hard steel containing an excess of graphite, and on the condition and distribution of this element largely depend the physical properties of the casting. This strong analogy makes the results obtained from cast iron interesting for the steel metallurgist. Unfortunately, the Articles of Association preclude the inclusion of small steel castings within the scope of the work of the British Cast Iron Research Association, and it is now up to the manufacturers of small steel castings to provide for themselves a research organisation. It should be unnecessary to point out that small steel castings suffer more foreign competition than iron castings, and it is to be regretted that it is not always a question of price which decides the buyer in the placing of his order. The question is further complicated by the fact that quite often the foreign castings are made by a steel process often looked upon with disfavour by British manufacturers. Assuming that there are about 150 manufacturers of steel castings in Great Britain we feel sure that there is ample scope for an independent Association.

Filtering Cast Iron.

According to a lecture which Mr. J. Feasey gave before the London Branch of the Institution of British Foundrymen, two important American foundries consider it worth while to insert metallic filters in the runners of their moulds. It is to be noted that the scrap made in the one factory, The Nash Motor Company, is 16 per cent., and in the other, The Alyns Ryan Foundry Company, 20 per cent. Naturally, when discussing discard, the type of casting made must be taken into consideration, but we gather that the figures quoted must be excellent for the class of material turned out, otherwise they would not have been submitted. It was pointed out, however, that in the former case the figure quoted, 16 per cent., had previously been as high as 40 per cent. We are unaware as to whether the introduction of filtering contributed in any marked degree to this improvement, but should this be the case, the proposition is such as would commend itself to many British foundry managers.

On the Continent patents have been granted to an Italian engineer, Signor Cesare Brunelli. In a circular letter sent out by the patentee, it is claimed that by using filters, not only is the casting kept free from slag and dirt, but also blowholes and their contributory causes are eliminated. He even goes further than this by claiming that runners, risers and machining allowances are to be dispensed with. To the major portion of this we cannot agree unless he largely supports his statements by "cast-iron" proof. We can imagine that some benefit might accrue from the checking of the stream, and possibly from the disengagement of some of the trapped gasses at the strainer. Perhaps the inventor has in mind the splitting up of the stream of the metal into many small jets, which quickly freeze; but if this is the basic principle of his invention, it is certainly not novel, as it has long been practised in both iron and steel manufacture. Certain large, thin cylinders, for example, are cast by having a large reservoir feeding many small runners. If, however, the claim is purely for a means of keeping out slag and dirt, there is something to commend it; but it is questionable whether the method in this respect would be more efficacious than bottom pouring, tea-pot or a specially designed ladle, or, for large castings, the closing of the bottom of the runner cup until full, and then maintaining full. As with most new processes, we anticipate that it will eventually be found suitable for some well-defined class of work.

XUM

Large Ingot Mould.

In our last issue we gave some details of what is claimed to be one of the largest octagonal ingot moulds ever made in this country, which was cast recently at the Newhall Road Works of Messrs. the Brightside Foundry and Engineering Company, Limited, Sheffield. We are able to give some further particulars. The length of the casting was 15 ft. 2 in., while the largest external diameter was 117 in. The thickness of metal varied from 13 in. to 15 in.

Owing to the necessity of pouring the casting quickly it was arranged that four ladles should be used, namely, one of 45 tons, one of 24 tons, and two of 17 tons capacity. Although the full melting capacity of the works was not used, the ladles were all filled in 3½ hours and the job was cast by 2 p.m., thus giving time for feeding before the closing hour.

The mould was then left covered up for two weeks to anneal before stripping commenced.

Owing to the weight the whole had to be stripped in the pit, the casting afterwards being lifted with the 150-ton crane to finish dressing.

The dimensions of the casting were so near the limits of the railway company's gauge that special trucks had to be fitted up to carry the ingot mould slung on girders, as shown in Fig. 1. Great credit must be given to the Traffic Department of the Great Central Railway for their ingenious method of overcoming this difficulty.

It will be remembered that the mould was made for Messrs. the Darlington Forge Company, Limited.

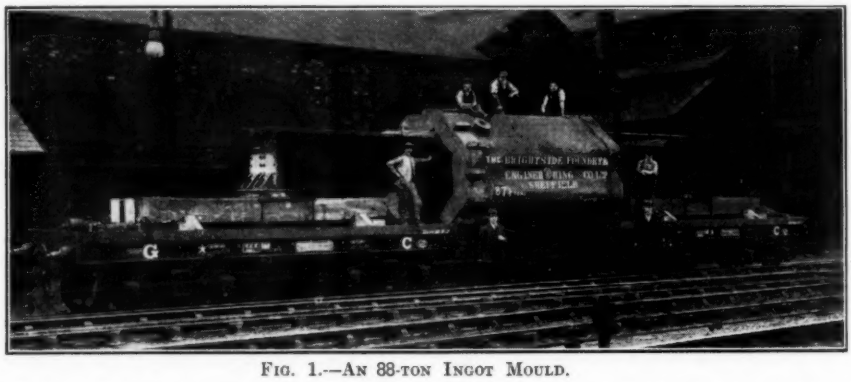

FIG. 1.—AN 88-TON INGOT MOULD.

Casting Multiple Grate Bars.

Monsieur Ch. Bichon, writing in the "Fonderie Moderne," points out that when casting grates such as is shown in Fig. 1, rejects often occur through the bars breaking at "a" during cooling. At first sight it would appear that the casting is well balanced as regards thickness and form, but on close examination it is clear that the cooling is not simultaneous for the three bars. If the upper portion of the mould is removed a few minutes after casting it will be seen that the centre bar is hotter than its neighbours. This is brought about by the fact that the side bars are in contact with a comparatively large volume of sand, which absorbs the heat from the iron much more rapidly, with the result that they cool quicker than the centre bar. The two cores separating the three bars have too small a volume to absorb the heat concentrated between the bars, resulting in unequal cooling of the three bars, and, consequently, the contraction crack shown at "a" Fig. 1.

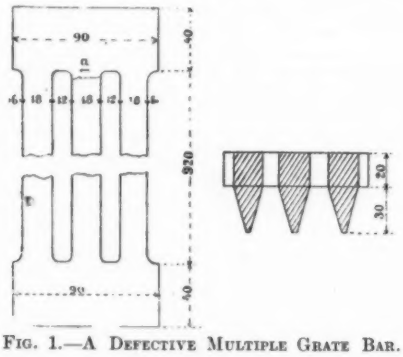

FIG. 1.—A DEFECTIVE MULTIPLE GRATE BAR.

To avoid this the author recommends two methods. The first consists in knocking out the grates whilst still red hot and rapidly rough cleaning them, especially between the bars, in order to bring about equal cooling. It is advisable to cover up the side bars with sand during cooling. The second method consists in casting at each side of the grate a bar of iron of a thickness equal to that of the bars in such a manner that the cooling of the outside bars will be analogous to the centre one. Once the cooling is equal the contraction will be uniform and the cause of the trouble will disappear. The objection to the second method is that of cost, but in practice it is possible to replace the two supplementary bars by castings of which the dimensions allow of a simultaneous moulding with that of the multiple grate and bringing about the desired heating effect for the outside bars. In any case, it is impossible to cast these bars in mottled iron, which is regarded as preferable for grate bars. It is advisable, in order to lessen the chances of breakages, to use a soft iron in which the contraction is 20 per cent. less than that of mottled iron.

Solubility of Graphite in Iron.

Rudolf Ruer and J. Biren, writing in a recent issue of "Zeitschrift für Anorganische Chemie," state that the solubility of graphite in iron is small even at high temperatures, and the graphite amounts only to a fraction of the total carbon content of the iron. Swedish bar iron was fused with graphite in porcelain, magnesia or graphite tubes placed in electrically-heated furnaces at 2,700 deg. C., and the fused metal was chilled by pouring it into a copper mould of the shape of a narrow pocket, only 1 mm. wide at the top and tapering down to 0.4 mm. at the bottom. With this rapid cooling graphite did not separate. The experiments were conducted in atmospheres of nitrogen, hydrogen, argon and carbon monoxide. Below 1,250 deg. C the iron did not take up any graphite at all; at 1,500 deg. the graphite percentage was below 0.1; at 1,710 deg. C. it had risen to 1.4; and it increased only slightly at higher temperatures. The total percentage of combined carbon was found to be dependent upon the rate of chilling and other conditions. The only crystals identified in the iron were graphite, cementite and austenite. As the total carbon taken up increased to 12 per cent. and more, the iron became less and less mobile; above 2,300 deg. C. the fused iron could no longer be poured, and above 2,500 deg. C. it was pasty. When cooled from these high temperatures the iron did not at once turn more fluid again. The loss of fluidity is ascribed to the dissolved carbon.

The British Cast-Iron Research Association.

The programme of the British Cast Iron Research Association was explained at a meeting held at the Chamber of Commerce, Birmingham, on May 23. In the unavoidable absence of Lord Weir, the President, the chair was occupied by Sir James McKechnie (Vickers, Limited). Others present included Engineer Vice-Admiral Sir George Goodwin, K.C.B. (President, Institute of Metals), Prof. C. H. Desch (Sheffield), Prof. T. Turner (Metallurgical Dept. of the Birmingham University), Mr. M. Deacon, M.I.C.E. (Sheepbridge Coal and Iron Company), and Mr. J. E. Fletcher (ex-President, Staffordshire Iron and Steel Institute).

THE SECRETARY (Mr. T. Vickers) announced apologies from Lord Weir, Sir H. Fowler (Chief Engineer of the Midland Railway Company, Derby), the Lord Mayor of Birmingham, Messrs. D. Vickers (Vice-President), P. W. Petters (Yeovil), and J. A. Penton (American Foundrymen's Association), and the Mayors of Dudley. Walsall and Derby.

THE CHAIRMAN recalled the fact that in 1916 the Government appointed a Department of Scientific and Industrial Research with the idea of bringing scientific knowledge into more intimate relationship with British industries. Germany and America had devoted a large amount of attention to such matters—much more, in fact, than Great Britain—with the result that they had got somewhat ahead of this nation.

The speaker summarised the steps taken by the Institution of British Foundrymen in the promotion of the Association, which came to a head at a representative meeting held in Birmingham on September 30 of last year. A provisional Council was then appointed, which had culminated in the formation of the British Cast Iron Research Association.

After examining in some detail the Memorandum and Articles of Association, the speaker announced a telegram had just been received announcing that the Board of Trade had granted a licence to the Association.

The carrying out of their programme could not fail to be of immense interest and benefit to users of pig and cast iron in all its forms; and he appealed on behalf of the Association for the support of all engineering firms. There was, probably, no material more essential in modern engineering progress than cast iron, in some of its many forms.

PROFESSOR TURNER emphasised the great national and practical importance of the Association's work, and showed how large a field of study had to be covered. He remembered when mild steel was being introduced some years ago, for a wide variety of uses, it was confidently predicted that that material would take the place of cast iron before the lapse of many years, and that eventually it would be necessary to go to a museum to find an example of cast iron. Yet the ironfounding industry had developed enormously, side by side with the steel industry. Obviously, steel requirements led to the employment of chilled rolls, cast-iron housings, bearings and many other essentials. The automobile industry was significant, because of the greater demand for malleable castings which had resulted. Really, the cast-iron industry was one of the most important metallurgical industries of the world.

Dealing with the wide field of service to be occupied, the speaker pointed out that there were as many varieties of cast iron as of steel. Some wanted fluid cast iron to give a sharp impression in the mould, others wanted cast iron sound and dense, to prevent percolation of water under pressure: some irons must be hard, others of high-tensile strength, while another variety must be specially suited to resist oxidation. At opposite ends of the scale were, on the one hand, large sized castings, and, on the other, the small nicknacks, of which a dozen could be put in the waistcoat pocket. That showed the wide scope for research, as well as for the collector of information, for the general benefit of the trade. The real problem for the Director of Research and his assistants would be not to find subjects, but to select the most important and the most promising, in regard to results, out of a wide range.

The story of the American malleable iron industry was practically a romance. America made ten times the number of malleable castings made in this country, and he thought they had justified their claim that the product was now better and more uniform than ever. That had been done as the result of manufacturers co-operating. When the Malleable Castings Association began its operations they were threatened by the introduction of steel to replace malleable iron, because it was not sufficiently trustworthy. By the adoption of certain definite specifications ascertaining how they could be complied with, and then insisting on compliance, they had largely increased the production of malleable cast iron, and in that way a most valuable material had been furnished for constructional purposes. They had not only advanced the scientific side of the industry, but had made considerable profit. The general effect of the American operations had been to raise the standard generally and to bring up the poor material to the highest specifications. Similar work would have to be done in their operations in connection with research association, so that the highest tensile-strength and toughness would be realised. Those high physical values could only be ensured by knowledge and constant attention. They needed also the unanimous support of the trade, following the example of the American manufacturers.

MR. M. DEACON said he had a feeling that the foundry trade had been too backward in the matter of scientific research, probably the most backward of the iron and steel trades; and in view of foreign competition they must put forth their very best efforts, far surpassing anything done in the past. The advantages they had to offer would include fully equipped laboratories, to which members would be permitted on certain terms to send their specimens for analysis. In addition, there would be a technical committee, dealing in a somewhat similar way with difficulties and problems arising in connection with their daily work. There was a great deal to learn, and nobody was perfect.

He attached the greatest importance to the literature emanating from foreign societies, which was to receive special attention. They had all met with the difficulty of becoming acquainted with foreign literature. One of the projects of the Association would be the translation of foreign literature, by a sub-committee, with the object of placing that literature at the disposal of their members. As a member of the Council of the Institute of Civil Engineers, his duty had been to review certain foreign papers for the Transactions, and in that way he had acquired a great deal of knowledge which otherwise he would not have obtained. That work would be of the greatest value.

Dealing with the question of economical production, the speaker said they would have to begin with cheap pig-iron. On all those matters the interchange of views, particularly in the matter of costs, must be of the greatest advantage, and could be of no possible disadvantage to anybody. It was of vital importance that England should wake up, and bring itself more into line with foreign progress with a view to the recovery of its old pre-eminence as the greatest manufacturing country in the world.

PROFESSOR C. H. DESCH (Sheffield) considered that no industry would so lend itself to that form of organisation as the cast-iron industry, having a large number of small firms associated with a small number of large firms. All of them had practical experience, but had not acquired the habit of working together for scientific purposes The cast-iron industry had been somewhat neglected metallurgically. It presented a striking contrast to the steel industry, which was admirably organised, all the greater firms having their own research laboratories and promptly communicating their latest developments, by means of papers presented to the Iron and Steel Institute. In that way the experience of one firm very

quickly became available to other concerns. For various reasons cast iron had received very much less scientific attention, yet it was quite as interesting as steel. Somehow, although pig-iron in the blast furnace received a great amount of attention, as soon as it was transferred to the cupola that attention was diverted. An exception to that rule was the Birmingham University, where, under the supervision of Professor Turner, a great amount of attention had always been given to cast iron.

The speaker dealt in some detail with the subjects calling for investigation connected with composition, treatment, conditions of manufacture, improvement of plant, control of casting conditions, etc. The skilled foundryman possessed a large amount of technical knowledge which he could not put into the language of text-books, and there was quite a field of useful work to be covered in the co-ordination of all that scattered knowledge, possessed by the practical man, with a view to its being made available for the requirements of industry. One important feature would be the establishment of a central bureau for the collection and interchange of information. It was a very common thing for papers to be met with casually and not utilised at the moment. An important sphere of service would be the collection of that material, so that it might be immediately available when it was wanted. There was really an enormous fund of experience, which, under the auspices of the Association, might become available to members.

It was hoped to utilise very largely existing staffs connected with laboratories and universities. There must be the fullest co-operation between research workers and practical men, so that the general knowledge might be made available for practical use. It should be possible to raise enormously the standard of practice in cast iron.

They had all been struck with the remarkable contrast between the finely equipped engineering shop and the often badly lighted and poorly furnished foundry. The foundry often gave them a sense of disappointment, through its lack of light, comfort and equipment. While there were exceptions, generally the necessity of foundry improvement had not been realised in the same way as in other departments of engineering. He believed that the Association would do much in the raising of the standard, particularly in regard to comfortable working and economical production in the foundry.

In conclusion, the speaker pointed out the necessity for better training of foundry workmen, and appealed to all connected with the foundry industry to place their information on the table, and combine for the general benefit. He hoped it might not be impossible to obtain the co-operation even of trade union leaders, not simply as individuals but as organised bodies, for the carrying on of research work. He believed that the Association had a magnificent future. The foundry was a fundamental industry on which engineering generally largely depended for its success, and he believed that metallurgical industries generally would share in the advantages accruing from their success.

ADMIRAL SIR GEORGE GOODWIN, K.C.B., said he had had a great deal to do with cast iron as an engineering officer of the Navy. Probably more cast iron was made for the Navy than for any corporate body in the world. He knew some of the difficulties connected with cast iron, and if the scheme of the Association could be carried into effect the whole country would benefit. Scientific research was absolutely necessary, but it must have a definite object in view, and he thought that also was provided for. He would, however, suggest, with regard to the collection of information, that it should always be provided in connection with an index, so that it could be immediately available when required. While theoretical training and practical work were both excellent, it was most essential that the two should be brought into co-operation. There was a great deal of knowledge to be obtained from the men who did the everyday work in the foundries. He was a little staggered by one statement made in connection with their programme—it was said they hoped for results with as much certainty as those now obtained with steel. He thought cast iron at the present time was much better than some steel that he had seen. He was prepared to agree that methods in connection with the steel trade were better, though why they had not produced better steel he did not know. In conclusion, the speaker said that the Association had started better than any other Association he had known, and, if that programme were conscientiously carried out, it would do very well. He would suggest, however, that they had not sufficiently provided for the opinion of the users, who, after all, had to be satisfied, and were often able to give them the advantage of valuable and interesting experience.

The meeting concluded with a vote of thanks to the Chairman, proposed by Mr. I. E. Lester, and seconded by Mr. Walter Macfarlane.

Sir James, in acknowledging the compliment, expressed the hope that the Association might continue to have the very valuable help and guidance of the speakers.

Heat Treated Chrome-Molybdenum Steel Castings.*

Some experiments have recently been made in the production of chrome-molybdenum alloy steel castings by the Michigan Steel Castings Co., Detroit, which afford interesting results. The steel was made in electric furnaces, and the castings, which were of various sizes, were subjected to a special heat treatment. The composition was approximately:—Carbon 0.27, manganese 0.94, chromium 1.00, molybdenum 0.50 per cent.

The heat treatment to which the castings were subjected was as follows:—

Annealing at 889 deg. C., and held for two hours at 851 deg. C. Then quenching and drawing at the different temperatures shown in Table I.

TABLE I.—*Showing the physical tests of the test pieces taken from the castings after heat treatment.*

Drawn at Deg. C.	Elastic Limit, Tons per Sq. In.	Max. Stress Tons per Sq. In.	Elongation, Per Cent.	Reduction of Area, Per Cent.
[566	59.0	63.2	8.0	30.8
	63.2	68.7	10.5	28.7
621	48.0	55.7	18.0	47.9
	51.5	58.8	14.0	37.2
677	36.6	46.4	20.0	50.3
	39.7	49.3	20.0	43.0
705	33.9	44.4	22.0	52.7
	34.1	46.0	18.5	52.8
732	29.7	44.6	21.0	54.1
	29.4	44.4	21.0	51.1

A feature of these results is the high reduction of area combined with unusually high tensile strength. Still more striking is the range of elastic ratio. The best results are those showing the greatest elongation and reduction of area, combined with a high elastic ratio, obtained when the drawing takes place at 667 deg. and 705 deg. C.

It is stated by the company that a number of the castings of the above composition and heat treatment were in the form of 3-in. diameter shafts, while others were cast in blocks, which were used by a large steel company as hammer blocks. Some of those in shaft form were used as axles in which service excellent results have been reported, while of the hammer blocks equally satisfactory results are recorded.

IRON AND STEEL INSTITUTE.—As recently announced the autumn meeting of the Iron and Steel Institute will be held, by invitation of the Comité des Forges de France, in Paris, on September 5 and 6. At the conclusion of the meeting in Paris, alternative visits have been arranged to works in Lorraine and in Normandy, and a party of the members has been invited to visit the Creusot works of Mm. Schneider & Company.

* "Iron Age."

Fire-Bars.

By A. B. SMITH.

The following is a new method of pattern-making and moulding section bars which are designed for use with very fine slack-dust. Every foundryman knows the petty difficulties and waste accruing from this class of fire-bar. The price ruling for this class of work calls for quick and cheap production, and is always termed "a boy's job,"

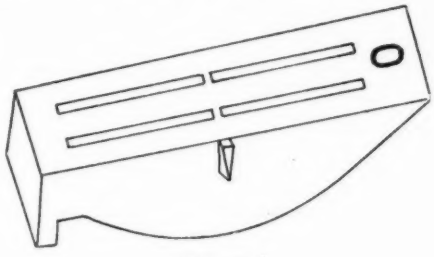

FIG. 1.

especially by those who have never made one, and therefore do not know why or how waste occurs.

If the patterns could be introduced into the foundry as a casting instead of the tainted name of fire-bar, it would be given to a good man, and in nine cases out of ten would be dried on account of the fineness of the cores. The writer recently made a quantity of these bars, the original pattern being in one piece as shown in Fig. 1. Trouble was experienced by the cods breaking in the "loosening" or "rapping," the depth of the cod being 4 in., the top being ⅛ in. wide and the bottom 1 in. Thus it will be seen that in

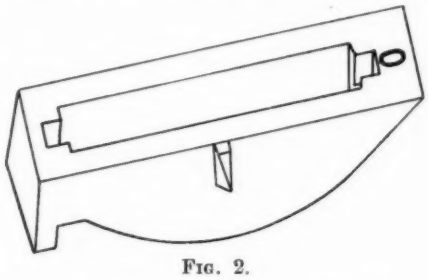

FIG. 2.

"sprigging" or "nailing," there was practically no sand between the sprig and the walls of the casting, and the following method was decided upon:—

Pattern. — It was ascertained that when the pattern maker built the original pattern the bars were made separate and screwed together after. The system of working them loose was therefore possible, and was decided upon.

Moulding.—The original system of bedding in the floor was observed, iron patterns being used, the centre bar is slipped in the slot (Fig. 2), wiped over with paraffin, turned over on a piece

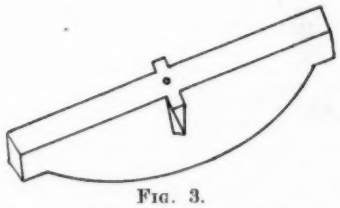

FIG. 3.

of board and sifted sand thrown in the cores. It is then picked up and turned over carefully by hand, care being taken to prevent the sand slipping out until the pattern is in position in a prepared bed in the floor; it is then tucked around and rammed up to the joint. When the top box has been rammed up and removed, the benefit of the loose bar (Fig. 3) will be observed. The pattern barely needs any rapping or loosening, thereby the cores are not subject to being broken or cracked; when withdrawing the pattern, the centre bar is drawn first and the frame next, when the simplicity and ease of the job reveals itself.

Using a fixed pattern, the rapping that is entailed causes further hardening of the cores, and consequently broken cores and subsequent patching and repairing and resultant wasters, which is prevented by this system, which is as near foolproof as possible, the waste being only about 2 per cent.

Fig. 4 illustrates another method of making fire-bars which is very much in use in the Midlands when making quantities of single bars from one pattern. Many foremen know the disappoint-

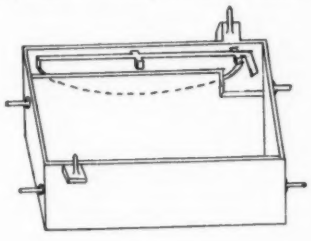

FIG. 4.

FIG. 5.

ment entailed when bedding in, say, four or five in a box with single paterns, and on completion of the last box, to find one or two "married" or burst.

Fig. 4 is an ordinary deep box, and shows a loose bar wedged in flush with the joint, a gap being made for the runner; Fig. 5 is the bar or stay. These are cast open-sand, and wedged in position. By this method the job can be carried out with unskilled labour.

The Daily Checking of Silicon in Cast Iron.

Mr. Christian Kluytmans, writing in a recent issue of the "Fonderie Moderne," states that when castings come out irregularly founders are far too prone to blame either the pig-iron suppliers or their staff. Very often a lack of reason and method is really the cause, and usually the faults can be ascribed to the silicon content in each day's casting. Therefore it is advisable to check the silicon every day, and even two or three times every day. Chemical analysis is not at all necessary, as the silicon content can easily be ascertained in the foundry itself. Merely a box and a piece of iron forged to shape by any blacksmith and some sand is necessary. This test dates from 1887, and was devised by an American, William Keep, whose name the test still carries.

First of all, it would seem desirable to run over rapidly the influence of silicon on cast iron, which is as follows:—(1) It increases the fluidity: (2) it precipitates the carbon in the graphitic state; (3) softens the iron; (4) reduces the chill; (5) diminishes the contraction. The first property shows itself during casting, the second by fracture, or, better still, by the aid of the microscope or analysis. The third and fourth with a file or machining, and the fifth by measurement. The last two properties can be used as test properties by the measuring of the contraction and the depth of the chill. The results obtained should be written in a special book, and a diagram made out every week. The test essentially consists in casting a trial bar in an iron mould of definite dimensions which does not touch the bar except at the two ends, thus producing chill by quick cooling and also bringing about the contraction.

It should be easy to lay down several boxes, three, for example, in such a manner as to give the trial bar at the moment the cupola starts melting, towards the middle of the casting and at the end of the blow. This should give a useful average. As the distance between the two ends of the sample pot is known, it is easy to measure the test-bar to obtain the contraction.

To measure the denth of the chill it should suffice to grip the test-bar at the ends and in the middle in a vice and to hit the overhanging portion with a chisel. The fracture will show the chill in the clearest possible manner. Needless to say, once the length and thickness of the bar has been standardised the results will only remain constant so long as these dimensions are not altered.

Designing a Small Foundry.

By Harold Measures.

The plan shown is intended to define the general lines of economical arrangement of any foundry, ferrous or non-ferrous, and delineates a ferrous foundry in general detail for the purpose of clear description.

The general scheme is shown with a view to the possibilities of expansion, with the minimum cost after the initial outlay of capital on the first portion is completed.

The aspect is given of a foundry near South London, which might require some revision in a different district, especially as far as interior light might be desired.

Ground Plan.—On the east is the main road with a space between that road and the first section of the main foundry building; on the south there is the main entrance and works road; on the west an open space for extensions and general loose stores, plant and stock, which might have to be moved for such extensions, and on the north side space is also shown for extensions, all of which is governed by the land available.

For the purpose of demonstration only the plan shows practically illimitable space, so that it may be used for large or small, restricted or unrestricted, areas.

Transport.—Only one main works road is shown, which in practice has been found to be the most economical in first cost and upkeep and generally in handling of goods and material. For large foundries two sets of rails are shown, one a standard 4 ft. 8½ in. gauge rail (to accommodate railway trucks and locomotive steam cranes) with a central turntable which would give access in four directions from any one given point. The same advantage could be obtained by points and crossings, but not with the same economy of space, and not with the convenience of keeping all lines in one uncurved direction. Turntables also mean less capital expenditure.

Speaking of a plan generally, the rail or siding inlet might come on to the foundry premises at any point, or even at an awkward point for layout purposes, and this is overcome by a turntable installed in any position, preferably where four independent lines can be installed, as is found necessary. The site can then be cut up by auxiliary turntables to suit individual requirements.

Before building operations are commenced a turntable should be placed at A, so that all materials can be brought alongside the building site. When the building is complete the same lines are to be used for the conveyance of all foundry stores and stock direct to the cupolas or foundry, and material in castings, etc., loaded direct from the foundry to trucks from the door shown at B. This door is also to be used for loading road vehicles, as the rails are to be laid flush with the surface of the road.

Door C also serves for loading road vehicles, but more especially for the transfer of large boxes and tackle from the foundry to outside. It will be noticed that an auxiliary line connected to main track is shown to this door, and also an overhead extended gantry from the foundry part way out only. This is designed so that if an extension to the main building is required the crane gantry will form an extension permanently without alteration. Therefore, it will be noted, that from one side and one end goods and materials may be brought to and taken from the building to the rail or to the main roads practically by mechanical or labour-saving devices without interfering with extension to any extent. Also it provides for the daily removal of boxes and other plant to be manipulated at will. The same crane power, both loco and overhead, also serves the handling of castings to fettlers and trimmers.

An auxiliary line of light rail should be provided for cupola service. Turnover four-wheel skips are labour-savers in bringing coke, iron, etc., direct from the store yard in the skips and taking them up to the stage in a lift—preferably electric. In the arrangement shown in Fig. 5 the rails run across the lift floor and form a continuous road track when the lift is in position at the ground floor.

Trimming Shops.—This department is shown outside the foundry, so that no floor or sand space of the main building is occupied by unskilled labour, with the added advantage of keeping the foundry clear and clean.

Cupolas.—In Figs. 1 and 5 there are three structures:—(1) Emergency 20 cwt. per hour tip over; (2) 4 ton or larger, belt driven; (3) larger still, or provision for same. All these should be on the direct-coupled fan principle, and of belt type. Melting can then generally be reckoned to commence in fifteen minutes from the time the blast is opened. The general detail of doors, cupola staging, etc., require no description because they are merely constructed on details of convenience to specific requirements.

Main Building.—It will be seen that the one end, or front, and the south and north sides are shown in brick to indicate supposed permanent boundaries. The west is a temporary end only. Side lights are provided in the east and south only; the main light, and also to the annexes, being from the roofs. This, by experience, cannot be improved upon, especially if running boards for cleaning the glazing are provided, as shown in Fig. 2. An open ventilator is provided at the apex, which may be open or closed at discretion.

The whole of the main building is devoted to productive work, that is, mouldings, with the exception of the small space occupied by the sand mixers. This is necessary to get the sand direct from the railway trucks to the foundry without second handling. The point of entrance is merely a matter of convenience.

Cupolas are entirely outside the foundry building, and no space is lost in the foundry except a few square feet occupied in dressing and storing ladles.

Crane Provision.—Two overhead travellers run the full length of the building, and each are provided with two sets of lifting gear so that one traveller can simultaneously take two ladles, or two boxes, down the floor. The temporary end of the building is provided with hinged shutters so that the travellers can run out of the foundry into the fettling shops and yards as necessary, which shutters automatically close as the travellers pass in or out of the main building.

The whole of the building should be limewashed inside, and all steelwork, travellers, etc., painted a bright cream, which to an extraordinary extent attracts from the roof lights and diffuses the light on to the floor.

Auxiliary Buildings.—Between the main moulding shop and the next main building at the east end are shown the works manager's or foreman's office, which are approached from the main office building by the main entrance corridor, which, whilst serving as the main entrance also serves as the entrance to the works, foreman's office, pattern stores and pattern shop. On arrival patterns would be tendered to the office and placed in the pattern stores for records to be taken, and left there until the foundry requires them or they can be transferred to the pattern shop. Similarly, patterns from the pattern shop go into the pattern stores, where they remain until required. Patterns, when no longer required, follow the same routine, and so all patterns not actually in use are always in the stores when once delivered, completed or finished with. They are accessible to the drawing office, foreman and works manager at a convenient central point.

Core Stoves.—These, as well as the core shop, are served by the overhead travellers in main building and by rail tracks and turntables. The doors are of the steel panel type in guides actual by balance weights, as shown in Figs. 3 and 4. With this system no floor space is taken up by doors. The stoves are put in this position with doors facing the shop instead of the reverse way so that when the doors are open the heat comes into the shop in winter, which is an advantage, and is obviated in the summer by small ventilating fans. This is not usually necessary, as the main

ventilating fan, which is fixed in the end of the building, is always sufficient to keep the shop cool and the atmosphere clear. The fires should be having to open the main door to make up the fires. These are more efficient, economical and less costly for labour than underground fires, and

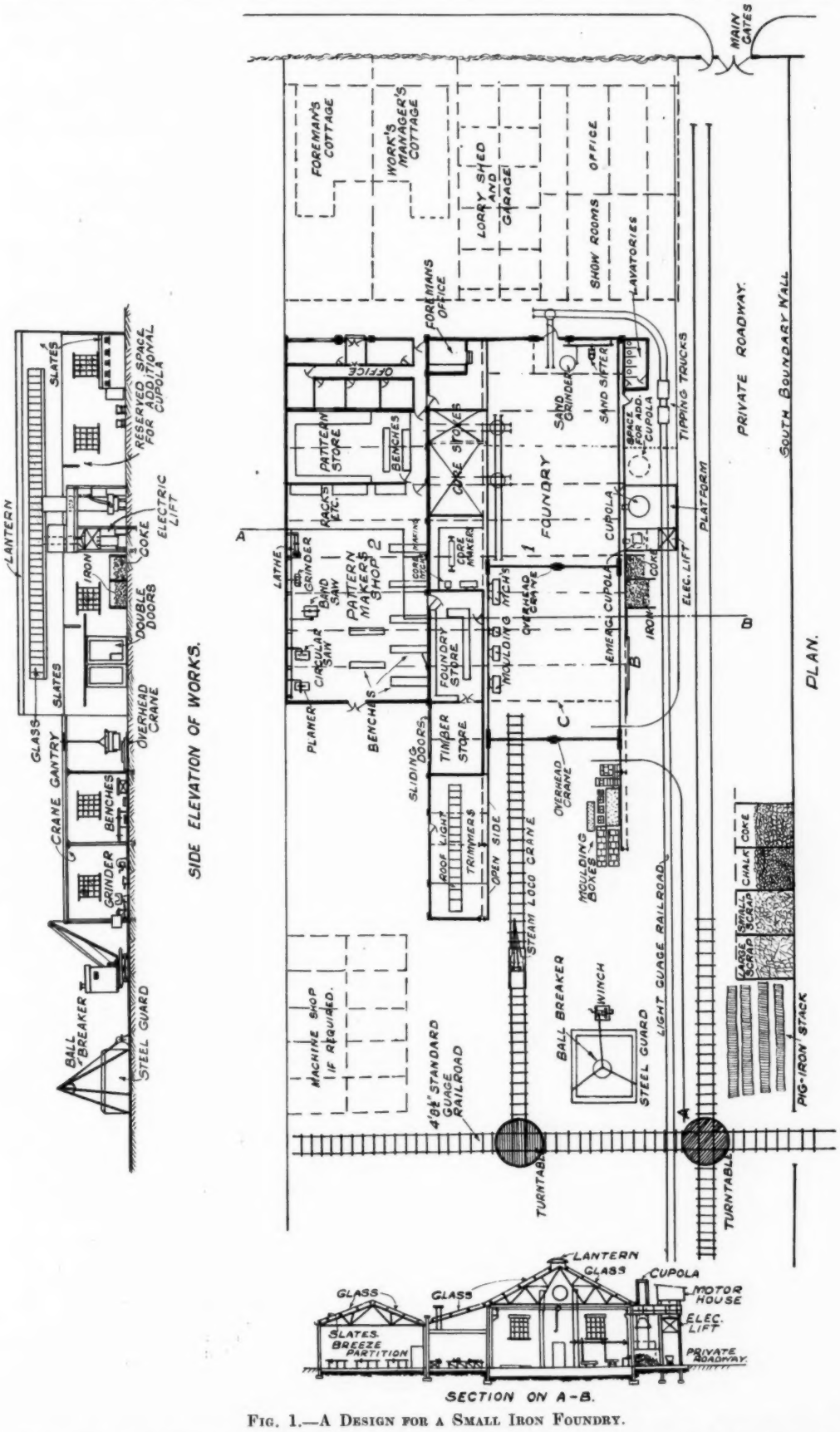

FIG. 1.—A DESIGN FOR A SMALL IRON FOUNDRY.

above ground, as shown in Fig. 4, in straight bar grates with damper door and charging door outside of stove, consequently losing no heat by cheaper than hot water or steam heating. Gas or electricity may be used, but are less economical.

Foundry Stores.—As foundry requisites are

nearly all man-handled, it has been arranged for a passage way between the pattern shop and stores, which is also accessible from office, main entrance, with an additional entrance direct to

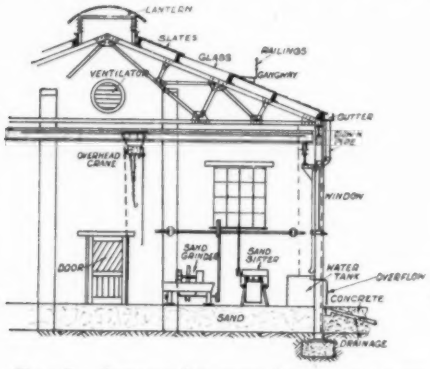

FIG. 2.—SECTION SHOWING OVERHEAD CRANE AND GENERAL CONSTRUCTION.

the foundry. There is also the outside entrance for bulky goods in the temporary (west) end.

Conclusion.—Labour-saving devices for the foundry can be summed up by specially noting:—For the office: (a) A modern electric printing machine for drawings and duplicates; (b) a sign-on time recorder; (c) a Comptometer, or calculating machine. For the works: (a) A modern

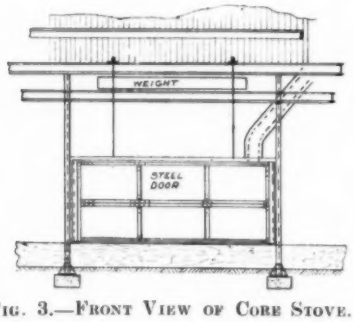

FIG. 3.—FRONT VIEW OF CORE STOVE.

time recorder; (b) a weighbridge and scales; (c) all such items as moulding machines, geared ladles, and assembly machines are all too varied for individual reference here. For the pattern shop: (a) Lathes; (b) large and small circular saws; (c) band saws; (d) planing and thicknessing machines; (e) trimmers; (f) discs. All of which should be left to the choice of a competent patternmaker.

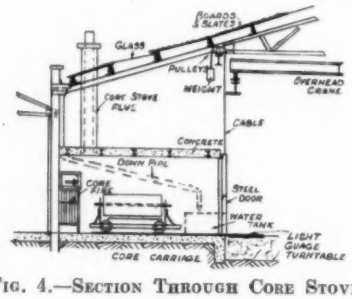

FIG. 4.—SECTION THROUGH CORE STOVE.

For the sand shop: (a) An edge runner mill with two types of rollers, viz., skeleton and solid; (b) a power sifter, portable electric sand-sifters should be provided to sift sand in any part of the foundry wherever a moulder requires a heap of sand; and (c) coal dust mill. For the core shop: (a) Mechanical core-making machine up to 3 in. diameter, and direct-act piston machine for up to 7 in. diameter; (c) mechanical binder for large cores. For the stores: A dormant weighing machine and scales. For the trimming shop; (a) A rumbler; (b) double-ended emery wheels; (c) grindstone; (d) a small forge is an advantage for the repair of tools; (e) a strong power drill is an item for consideration. Swing grinders for large castings and pneumatic chippers should be considered.

In the opinion of the writer there should be no second floor to any department of a foundry, but in many instances space would not allow of such plans. There is no doubt that the ground-floor principle is the most economical in every way as regards labour costs.

All machines should be separately direct-driven by electric power. The economy of power and labour compensates for the initial cost, and gives the advantage of only one machine being out of use in the event of a breakdown.

The plan and design can be enlarged or restricted at will in practically any direction. All departments may come under one or more bays at dis-

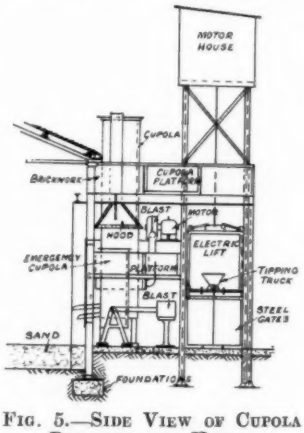

FIG. 5.—SIDE VIEW OF CUPOLA PLATFORM AND HOIST.

cretion, but the two-bay principle favours initial expenditure.

It must be observed that little or no reference is made to a machine shop. The doubt is beyond discussion that such is an adjunct of the first importance to a foundry, and although these are separable there is an amount of repair and upkeep work to be considered, and at present-day costs it is wise to consider the advisability of installing a small plant both for foundry maintenance and as an additional adjunct. This, however, is no part of this article.

For the purpose of equitably dividing any capital expenditure it has been assumed that a sum of £15,000 might be laid down as building capital. A completely equipped iron foundry on the lines suggested could be installed, capable of turning out 15-20 tons per week of engineer's castings of high quality, in which labour costs on this plan can be guaranteed to be less than any existing in London to-day.

THE HUME PIPE AND CONCRETE CONSTRUCTION COMPANY.—According to Indian papers just to hand, this Company have recently concluded negotiations with the Tata Construction Company, Limited, of Bombay, with the result that a Company is now in course of incorporation in Bombay with a capital of Rs.20,00,000 (£200,000 at 2s. the rupee). The Company will be known as the Bombay Hume Pipe Company, Limited. It will manufacture outside the Presidency of Bombay for the purpose of sale to Tata Sons, Limited, and has purchased the pipe factory at Jamshedpur for Rs.5½ lakhs (£52,500). The consideration for the licence to manufacture Hume pipes will be 1,000 promoters' shares of the par value of Rs.1,00,000 (£10,000), fully paid up, and in addition there will be handed to the Mother Company fully-paid ordinary shares in the original capital of the Bombay Company, as a further consideration, in such proportion to the issued capital as to secure for the Company about one-third interest in the Bombay Company. The manufacture of pipes is now being carried on at Seebpore, and they are supplied under contracts amounting to several lakhs of rupees (1 lakh = £10,000). The Company have also started factories at Mandalay and at Korari (Jhansi) for the purpose of supplying pipes for the new water-supply schemes at those places.

Some Castings for Internal Combustion Engines.

Water-Jacketed Cylinders.

By "Ben Shaw" and "James Edgar."

The Pattern Making.

It will not be possible to review the whole field of internal-combustion work in this series, but only a small portion of it. Twenty years ago it would have been a small matter, but with the development of the idea of the gas engine, innumerable types have been introduced, differing considerably in details but worked on the same principle. For instance, there is the gas engine proper as apart from the oil engine, and the latter may be divided broadly into two categories, those designed for petrol or other light oils, and the heavy-oil engines of the Diesel and semi-Diesel types. We have not the space, nor would it serve a useful purpose to enumerate or explain the technological details of the various types of engines in articles which are for the purpose of discussing the various difficulties of the patternmaker and moulder in translating the ideas of the designer into actual castings. For generations engineers were satisfied with the reciprocating type of engines, with comparatively slight modifications of detail in design, and although the turbine has given greater scope there is not the variety of types as with internal combustion engines.

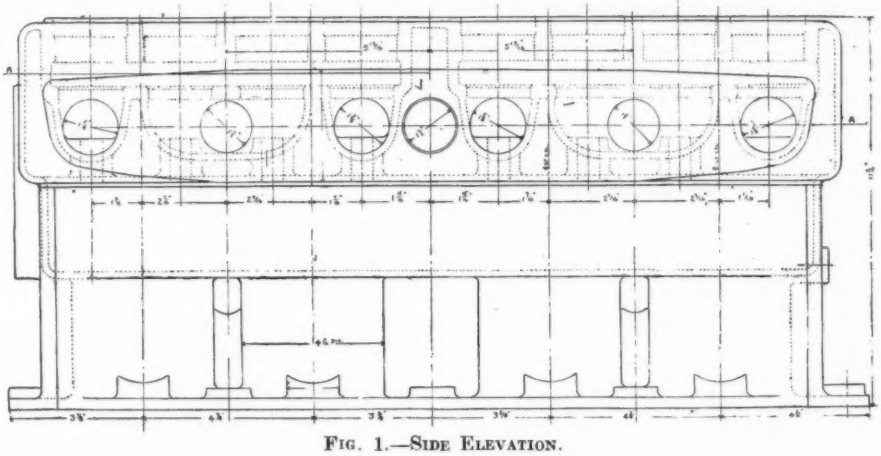

FIG. 1.—SIDE ELEVATION.

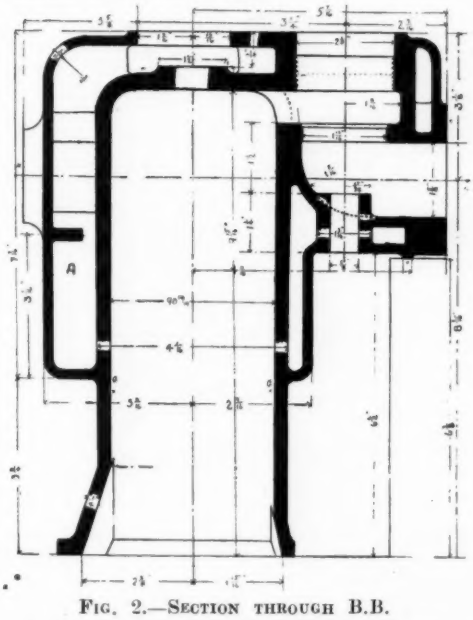

FIG. 2.—SECTION THROUGH B.B.

In this series we shall confine our discussion to the types of engines used for motor vehicle work. The heavy oil engine is peculiarly suited for big marine work, but is quite ruled out for road work, and also—with exceptions—for light marine work. Even in considering petrol motors it is difficult to decide on an engine which combines all the difficulties and intricacies of design which have to be coped with by foundry craftsmen. The cylinder, crank-case, etc., which will be dealt with in these articles, are of a representative type of engine, and the methods adopted in making the various parts should be applicable to almost any other automobile engine. It is an engine made by the Vulcan Motor Engineering Company, Southport. The cylinder, it will be observed, is water-jacketed. A discussion as to the relative merits of water and air cooling would be out of place, but it may be assumed that water cooling is usual for other than cycle-car and motor-cycle engines, and there is at least as much difficulty in casting a water-jacketed cylinder as in casting one with vanes for air cooling.

Exceptional accuracy in workmanship is necessary to get good results in this class of work. This does not mean that in big marine or stationary engine work accuracy is not important, but it does mean that whereas many measurements on a large reciprocating cylinder or turbine casing may be satisfactory if within 1-16 in. of the drawing size, this is not allowable on motor engine work. The patternmaker should not be satisfied with "nearly" correct. The metal is too thin to allow of any liberties being taken with it. When a casting is 1½ in. or 1 in. thick, a 1-16 in. error may not spoil it, but it is different when the thickness of the metal is ¼ in. and sometimes only ⅛ in. Extra labour in the pattern-shop will be repaid later in the machine and assembling shops.

The opinion commonly expressed in pattern-shops that nothing should be left to the moulder is liable to be carried too far in general work but not in motor work. It is obviously ridiculous to cut solid fillets or even glue leather fillets round a big bedplate, as such large fillets can very easily be made by the moulder sufficiently accurate and in little time. But a 3-16 in. or ¼ in. fillet in motor work may be defining a thickness of metal, and should be done in the pattern-shop. Apart even from the metal thickness, weight is an important factor, and is kept down to the lowest limit.

An important reason why it is profitable to pay attention to the minutest detail in motor work is that, except for an experimental job, large quantities are usually required off the same pattern. With ship work and with stationary engine work it is not usual for more than two or three castings to be required of the same size and design, and even for machine tool work it is seldom that the large quantities required for motor patterns are made. For a purely experimental job it is waste to make a more elaborate pattern than is actually necessary to get a trial casting, but once a design has been determined upon, and hundreds

or maybe thousands of castings are required, no effort should be spared to make the pattern so perfect as to reduce the moulders' labour to a minimum.

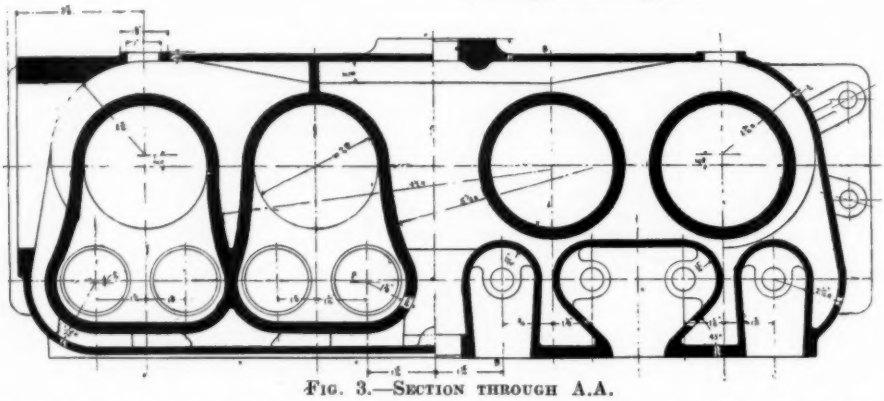

FIG. 3.—SECTION THROUGH A.A.

It may be profitable to consider the materials used in patternmaking for motor work. With regard to timber—because although for small work and air-cooled work aluminium patterns are usually employed—mahogany or baywood is best. For working up and for withstanding varying atmospheric conditions yellow pine is hard to beat. The best quality of yellow pine, dry, straight-grained and free from knots, is convenient to work and finishes well. The trouble is that it is easily dented, and if moulders are at all careless, easily split, and it is not always easy to repair such patterns as heavy patterns. Teak is sometimes used, but it does not take a really good finish, and it has other qualities that render it unpopular for patternmaking. Straight-grained mahogany or baywood is easily worked, and it stands foundry conditions well. Other timbers are tried for patternmaking from time to time, but they do not oust yellow pine and baywood.

The question of filleting and dowelling are also very important for this class of work. Wood fillets are not suitable for fine patterns. It is seldom that they are satisfactory even for straight work, although they serve their purpose for rough work.

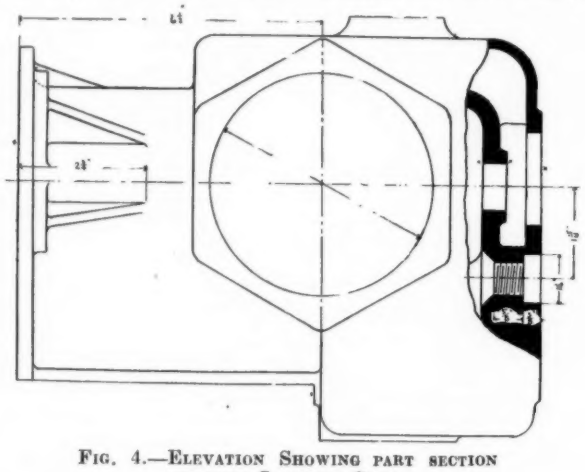

FIG. 4.—ELEVATION SHOWING PART SECTION THROUGH SPARKING PLUG.

Wax fillets used to be very popular in motor pattern shops, but as a general rule they are not as good as leather fillets. If wax fillets are used small dumb-bell-shaped rubbers should be employed of the correct diameter, to rub them into shape, the rubber being continually dipped into boiling water. Wax fillets are dirty to work with, because it is difficult to keep the wax off other parts of the pattern, but another objection to them is that if the pattern is placed near a stove they are apt to "run." The leather fillets have become popular

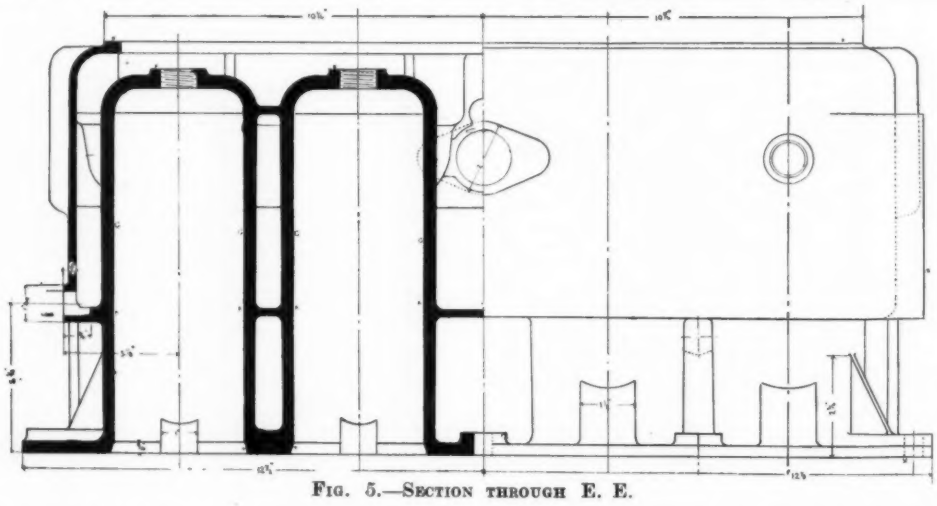

FIG. 5.—SECTION THROUGH E. E.

because they are easily fixed, they make a neat fillet, and they are permanent. Moreover, with some practice the skilled man can form a leather fillet round the most awkward shapes, using the rubber as for wax fillets. No loose fillet is comparable, however, with that carved from the solid

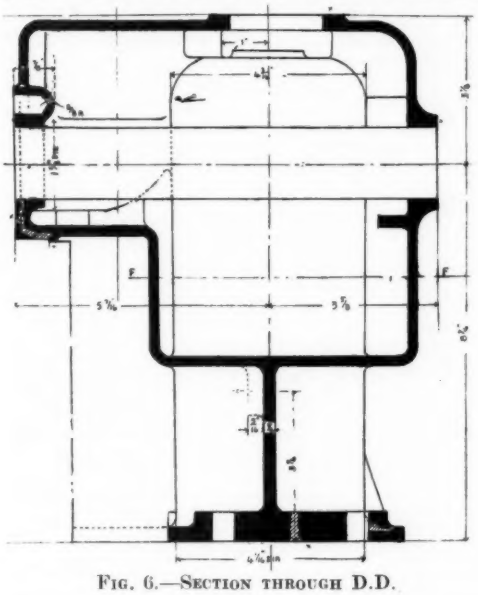

FIG. 6.—SECTION THROUGH D.D.

timber, but it is altogether too costly to carve fillets round all bosses and ribs. For loose pieces, however, the fillets should always be cut from the timber.

Metal dowels are nearly always superior to wood

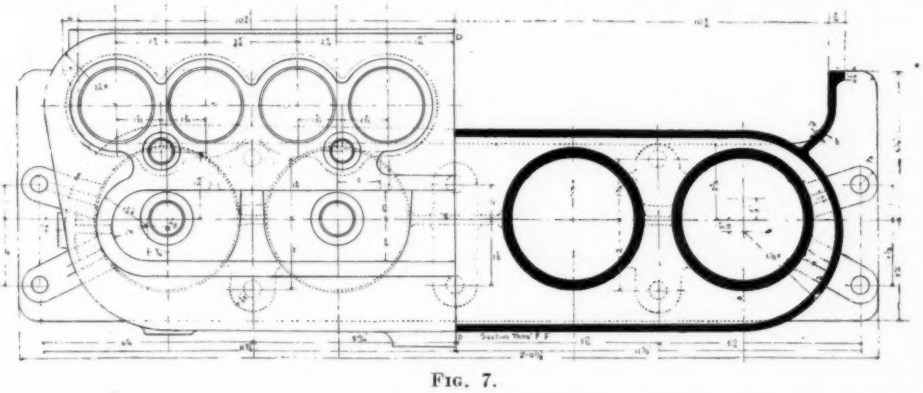

FIG. 7.

dowels, and for motor work are invariably used. Wood dowels usually tempt the moulder to use his knife, and thus spoil the dowel, and it is very difficult to get a nice, easy fit even in hard wood that can be relied upon to remain so.

As with other classes of patternmaking and moulding, practice varies in different shops, but

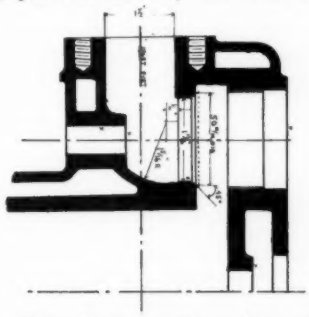

FIG. 8.—PART SECTION THROUGH INLET VALVE.

the aim of all patternmaking is to reduce the moulding costs. A great proportion of motor work can be done conveniently on moulding machines, and some firms contrive to do even cylinders on machines. It is questionable, however, if making a water-jacketed cylinder on a machine is very advantageous, because most of the work is in making the cores, and the handwork here cannot be eliminated. Plate moulding as distinct from machine moulding is frequently resorted to. There is also the question of whether a job should be moulded on-end or partly longitudinally. Endwise moulding, experienced moulders are agreed, gives better results and sounder metal, because a

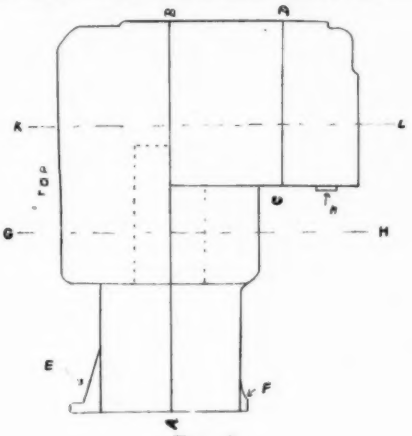

FIG. 9.

suitable head can easily be arranged for, but endwise moulding has for some unaccountable reason never been popular in this class of work. It may be admitted, of course, that much jacket coring is more troublesome when a job is moulded on end, but it is regrettable that more discrimination is not used in deciding on methods of patternmaking and moulding. A practice is adopted in a shop, and under no circumstances is it departed from.

It may not be out of place here to discuss machining and contraction allowances. Unlike large work it is not customary to vary the contraction allowance for length, width and height. The contraction is fairly uniform, and there is not usually such variation in metal thickness as to cause unequal cooling. As a general rule it is safe to allow 1-10 in. per foot for contraction, but it depends to some extent on the metal mixture. Machining allowances vary in different shops, but

FIG. 10.

it is not usual to leave more than $\frac{1}{8}$ in., and this is sufficient if the patternmaking is high-class and adequate arrangements are made in the foundry. On some parts 5-32"in. may be left, but on others 3-32 in. is sufficient.

Figs. 1 to 8 show the cylinder. It is not intended to deal with the endwise method of construction at all but proceed on the conventional lines for this class of work, which is probably the best way for the job in hand. The reader is advised to study carefully the design before considering the patternmaking. In this class of work there are no real constructional difficulties, such

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as are met with on big work, for the experienced man. Patterns are invariably made from solid timber. Fig. 9 is a section of the completed body of the pattern. The pattern joints are made on the line A B and C D. As far as the making of the pattern is concerned, or its easy delivery from the sand, a joint at C D is not essential, but the moulder has no option but to make a joint through the valves in order to set the cores, hence the patternmaker must define the joints. That part of the pattern which is top in the mould does not present much difficulty. The parts of the cylinder which are beyond the jacket can be turned easily, and although the prints are not shown in Fig. 9 they are better turned as part of the bodies. Those cylindrical parts are best tongued into the jacket portion, with either turned tongues or parallel tongues as shown in Fig. 10. The parallel tongue is perhaps the better, but it takes more care to fit. It is not proposed to suggest the best tools to use for performing the various operations described in these articles, a knowledge of the elements of patternmaking and moulding being presupposed, but it may be said that if parallel tongues are carefully gauged, planed and then tested with callipers, and a router is used to recess the main body, a satisfactory result is assured. Slovenly workmen may be satisfied with a joint made level

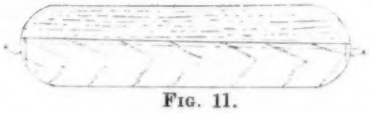


Fig. 11.

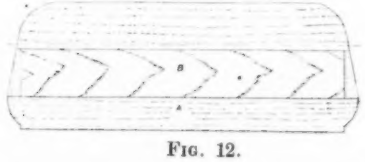


Fig. 12.

with sand-paper, or showing packing, but it is not creditable work.

The pieces E and F can be shaped separately and glued on. A section of the line G H is shown at Fig. 11. It will be noted that the centre of the jacket is on a different plane from the cylinder centre, and a decision has to be made as to whether it is better to drop the joint. It is much better in moulding and for core setting if the joint is on one plane, and the difficulty can be got over by dovetailing loose pieces at the ends of the body so that they can be drawn into the mould after the pattern has been delivered from the sand.

Fig. 12 is a section on K L, Fig. 9, and shows both joints. The bottom piece A delivers freely, but the middle piece B locks at the ends, and pieces have to be dovetailed on as explained for Fig. 10. These dovetails should be made separately from the pattern pieces, and may be about 5-16 in. to ⅜ in. thick with a quick taper in the

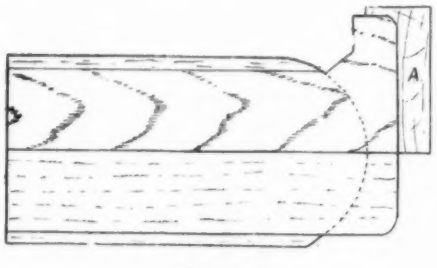


Fig. 13.

length so that they will free easily. The facing M, Fig. 9, and other portions that cannot conveniently be dovetailed, should either be wired or screwed. But even where a piece is not on the joint the dovetailing method is good. The dovetail can be made sufficiently long and planed flush with the surface, after which a round facing can be fastened to any part of it.

In assembling the pattern it would not be satisfactory to rely on screws holding the part B of Fig. 12 to the other jacket portion shown at Fig. 11. For good class work such as this, a butt joint, even if glued and screwed, is not reliable. The best way would probably be to tongue the two parts together. They may be glued first, and quite a good result would be obtained by carrying the tongues on the cylindrical ends all the way across the pattern. Some craftsman would carve the fillets at the junctions of the various parts of the body from solid timber, but this is needlessly

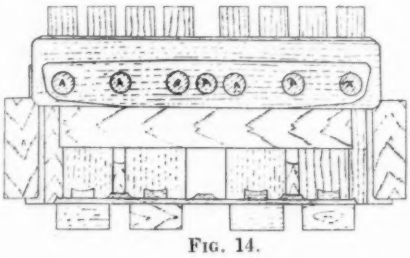


Fig. 14.

costly, and leather fillets should certainly be used here. Whether the facings on the top of the cylinder are better made separately and screwed on or carved in wood is debatable. In the writers' opinion, a separate facing with a square edge against which a ¼-in. fillet can afterwards be glued is best. Here it may be mentioned that for the benefit of those who have never used leather fillets, sprigs should never be used to fix it. It is surprising how often they are used, and they spoil the fillet. Thin glue is all that is needed.

It is not necessary to discuss such minor details—important as they are—as the making and fastening of small bosses and ribs. This much may be said, that dovetails are always better than dowels, screws, or nails. It may be difficult in all cases to get a fillet, but if necessary, and in order to obviate sharp or "feather" edges, recesses should be cut to receive ribs, when they must be drawn separately from the main body of the pattern. If a recess ¼ in. deep is cut to receive a facing or rib this assists in locating it in re-screwing the pattern, in addition to making a strong edge.

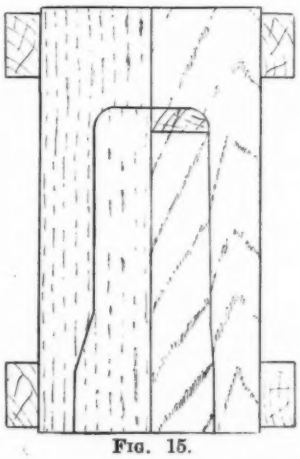


Fig. 15.

Sometimes, of course, sharp edges are only avoidable by considerable labour, and consequently are sometimes left. This would apply to the facings and ribs on the main flanges of the cylinders. The ribs that are showing plainly in Figs. 1, 5, and 6 between the cylinder should be "let in" to the pattern joint. If they have a "landing" of ½ in. or so they can be securely screwed from the joint.

The main flanges do not need much explanation. If the cylinder prints are turned as parts of the cylinders then the planed and finished flanges may be fitted over them, and screwed from the joint. It is advisable, however, to taper them slightly both at back and front. In motor patterns, as in all other patterns, taper should be left on all parts that will be lifted vertically from the mould.

The most awkward parts of the pattern are the brackets or feet which are shown clearly on several views, but most clearly perhaps on Figs. 6 and 7. It might be possible to make those parts as models of the required casting, and it would be good

practice if the cylinder was big and of the reciprocating type, but it would be decidedly foolish for a small job like this from which so many castings would be required. Drawbacks would have to be made by the moulder at both ends of the cylinder, and they would involve much more labour than making block cores which is by far the most satisfactory way. There is no danger, when cores are used, of the feet being moved out of position. There is also the possibility of the thin timber

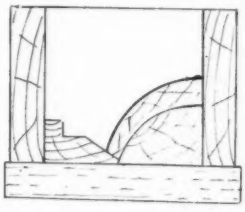


FIG. 16.

warping if shell patterns are made. Satisfactory block prints are shown in Figs. 13 and 14. They should be carried up to the pattern joint. These prints need not interfere in any way with the construction of the pattern as they are fitted between the flanges and the valve chest, and being comparatively small they may be made from solid timber.

Printing a pattern such as this is very important. The prints A in Fig. 14 which show the

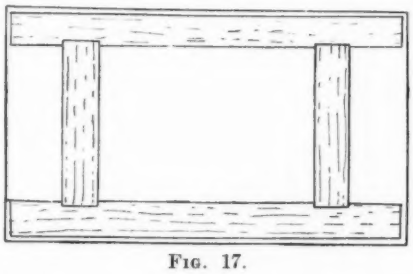


FIG. 17.

finished pattern need not be deep, as they are guide prints only. Some pattern-makers would shape these prints from the correct size at the bottom to $\frac{1}{4}$ in. or $\frac{1}{8}$ in. smaller at the top, and make the core-box to suit, but it is open to question whether this is an advantage in this case. The main prints on top and bottom of the cylinder should be about 2 in. long, and the faces should have a considerable taper on either side of the joint. Looking at Figs. 1, 3 and 4, it will be observed that there is a large branch with a hexagonal flange on one end of the cylinder. This will not give the pattern-maker or the moulder much concern, but a fairly large print should be left.

When all the facings have been screwed on, the finishing touches may be put on the pattern. Until this stage is reached no corners should be taken off. It is very difficult even for highly skilled men to so visualise the finished pattern that they can safely take off rounds before all the parts are assembled. To ensure accuracy in metal thick-

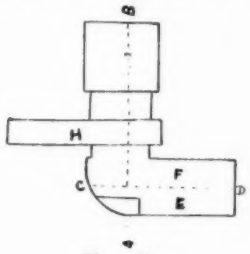


FIG. 18.

ness templates should be used for all rounds above $\frac{1}{2}$ in. In addition to finishing off rounds, and indeed, before these are done, all fillets should be glued on, and the whole pattern then sandpapered. It is usually necessary to test all loose pieces after the pattern has been varnished, and especially is this so in dovetails.

The Core Boxes.

The construction of the various core-boxes is considered generally much more difficult than making the pattern of a motor cylinder. The cores of the cylinder we are considering are most specially difficult, but nothing can be left to chance. Every detail of the core must be thoroughly understood by the foreman or whoever is in charge of the job. This is the only way to be certain that one core will fit properly into or against another, and that there will be no lumps of metal cast in corners, because the danger of leaving thick metal is almost as great as that of leaving thin.

The cylinder core-box itself is the simplest to make. It may be said that there is no question of strickling any of the cores. The cylinder core which must of course, be made in halves dowelled together is illustrated in section in Fig. 15. Here it may be said the core-boxes are frequently made of soft wood even when the pattern is made of mahogany, because of expense, but there is no logical reason for this. If a pattern is well made it will not wear more than the core-boxes, and

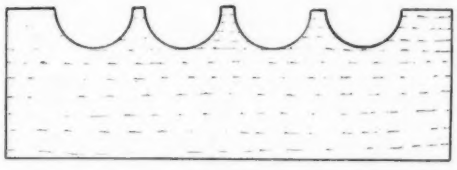


FIG. 19.

although it is in the inside and not on the outsides of core-boxes that matter, yet soft wood warps and shrinks more than hard wood. In nearly all cases patterns and core-boxes should be made of similar timber.

Without examining all the cores it is obvious by looking at the working drawings that it would not be satisfactory to make a butt joint of the cylinder core and that part of the valve core which joins it. On first examining the cores one is inclined to make that part of the valve core on the cylinder side of the centre line and the cylinder core in one box, but a difficulty at once presents itself—it would not be possible when coring up to set the cores because of the jacket core which is between the cylinder and the valve. The only practical way is to carry a print up to the centre line of the cylinder. This is shown clearly in Fig. 15. The cylinder cores change near the flange and templates should be used to make sure that the shape follows the pattern.

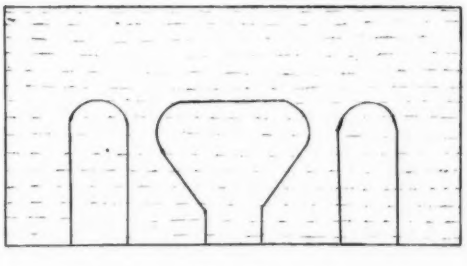


FIG. 20.

The foot or bracket core-box is comparatively simple, as will be seen from Fig. 15. It is a framed box with a bottom on which pieces representing the cylinder and the inside of the rib are screwed. While it is a fairly deep box it should not be necessary for the core-maker to unscrew if a slight taper is given to the sides. If it is screwed and not glued the core-maker will be able to loosen it if he finds it necessary.

The valve core-box and the jacket boxes are decidedly awkward. The valve box will be understood better if a section of the core is viewed quite apart from the main drawing. (Fig. 18.) It would be necessary to joint the box on the lines A B and C D. The part E would be dowelled separately to the part F. It would not be advisable to carve the three parts of this core-box, from single pieces of timber. Fig. 19 shows the cylin-

drical end cores the top and bottom halves being exactly the same. Fig. 21 represents the part H. From the core-maker's point of view this is the most awkward part of the box. By comparison with the width it is very narrow, but if the work is well done and slight taper is left it should stand all right. This core may be either cut through the bottom of the box or a thickness left which will form a bottom. The other parts of the box are not very difficult, but they take some time to carve, and templates should be used. Fig. 20 is a view of the line C D.

The troublesome boxes—those for the jacket

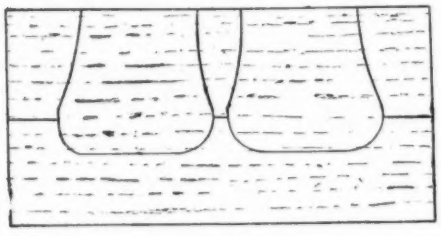


FIG. 21.

core, from reference to Fig. 2, will be perfectly clear that while the whole core could be made in one core-box it would be impossible for the moulder to set it. As a matter of fact, three core-boxes must be made. The top of the first box must be the centre line of the valve and the other two parts join on the cylinder centre line. In coring-up, the first jacket core is set, after which the valve core can be placed in position. Next to be placed is the middle portion of the jacket core, then the cylinder core, and finally the top jacket core. We are supposing now that the valve will be moulded in the drag, but even if the valve is moulded uppermost in the core, the same divisions of the cores must be made.

Figs. 26 and 27 represent one core-box for the part marked A in Fig. 2. Fig. 27 is a section looking towards A, Fig. 26. As will be seen, the width of the box is made of three pieces for convenience in cutting the fillets. The readers' attention is invited to the dovetailed parts at each

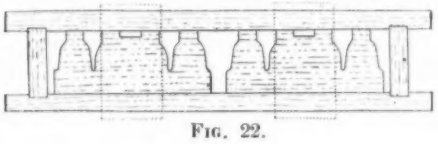


FIG. 22.

FIG. 23.

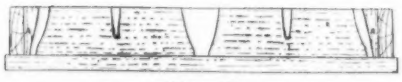


FIG. 24.

end. These are, of course, necessary because of the centres of the cylinder, and the jacket being on different planes. The cylinder bodies are not always made as shown. These are turned, and the fillet thickness is made with the grain at right angles to the cylinder. A better job, but more costly, is obtained by cutting circular recesses in the side of the box thus obviating sharp-edged fillets on the cylinders. The dovetails locate the cylinder easily, and are useful, although a batten must be screwed on the top and dowelled on to the ends of the box. After the core is rammed, the batten is lifted with the half-cylinder, and the dovetails immediately locate it for the next core. Objection may be made to the dovetails on the ground that they may jam when lifting, but if they are well made there is no danger of this.

The middle part of the jacket core takes more watching than the box we have just considered. The two sections Fig. 24 and Fig. 25 show it much more clearly than an outside view would do. The depth of the box is the distance between the centres, and it has to be made longer than the core length because the ends lock and thus loose pieces must be made and dovetailed to the ends of the box. (Figs. 24 and 25.) Fig. 24 is a view through the core that breaks into the cylinder, while F (Fig. 25) is through the centre of the valve, the top of the box in each case being the centre of the cylinder. From the core-makers' point of view this is the most delicate core of the cylinder, and the patternwork inside the box should be first class in order to assist him. There is not much room for leather fillets here, and the fewer the number of parts inside the box, the more certain is it that centres will be accurate. There is thus a great deal of carving in the box. It has not been thought necessary to show a joint view of this box, as it is identical with Fig. 22, which is a joint view of the top jacket core-box. The various pieces representing the valve body should be well screwed to the bottom of the box, as they

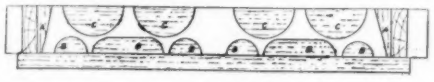


FIG. 25.

will not require to be loosened off in making the core. The cylinder body pieces C C C C, Fig. 25, must be fastened to a dowelled batten as already described for the other jacket box.

We may now briefly describe the last jacket box. The joint view, Fig. 22, will be better understood by reference to Figs. 2 and 3. Fig. 3 shows us that while openings are diameters at the face of the valve they immediately begin to spread, and this

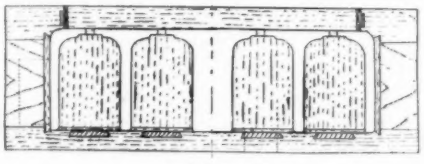


FIG. 26.

makes it impossible to screw any blocks on the bottom of the core-box. It could be done certainly by dovetailing the portions that are against the draw, but it would be a very clumsy job, and there is no other alternative but to fasten the entire internal blocks to cross battens as indicated in Fig. 22 by the dotted lines, and draw them from the top before the core is turned out of the box. The advantage of the battens being crosswise instead of lengthwise in the box is that room is

FIG. 27.

left for ramming up the cores. Fig. 23 is an end view of the valve chest showing that the branches are not separate as appears in Fig. 2.

There are various small cores on the cylinder which it is not necessary to consider.

Sometimes an endeavour is made to prepare all subsidiary core-boxes as separate boxes, but considerable discretion must be used in doing so as some of the cores have very little support, and few means of determining their relative position in the mould. The practice of making a dummy set of cores and having them assembled so that slight alterations may be made before the work is actually put in the hands of the foundry is to be commended in complicated work of this character.

With regard to the ribs, which are shown in the various views connecting the inner and outer walls of metal, they involve a considerable amount of labour. It is not satisfactory to simply screw them to the bottom or sides and relocate them for each core. When they are on the joint they should be checked into the sides of the internal blocks and made of timber sufficiently thick to allow of a template being cut where they join the metal, and the practice of "letting in," as it is called in some pattern-shops, should be followed wherever possible.

Institution of British Foundrymen.

BIRMINGHAM BRANCH.

At the concluding meeting of the session of the Birmingham Branch of the Institution of British Foundrymen, held on April 2, the chair was taken by Mr. F. Holberry (Branch President), and Papers were given by Mr. A. Wardle (Wolverhampton) on "Jolt Ram Machines," and by Mr. C. Heggie (Birmingham) on "Pattern Plates for Floor and Machine."

Jolt Ram Machines.

MR. WARDLE gave views of various types of jar-ramming machines, with a running description of their construction and operation. The jar-ram machine, he said, was the most generally applicable of all types of moulding machines. The saving of time on large moulds effected by such machines was really amazing, days of ramming being sometimes reduced to a few minutes. The sizes of moulding boxes could be reduced because of the ability of these machines to ram narrow walls of sand, which could not be dealt with by any other type of machine, and would be extremely difficult to ram by hand. Gases were allowed better exit from the sand during casting, the moulds being rammed with a varying degree of density from the pattern to the outside. Different sizes of moulding boxes could be used on the same machine, whilst either a hard-rammed or a soft-rammed mould could be produced by altering the length of jar. In his opinion, all moulding machines should be operated by power other than manual. Some hand-power machines had very ingenious means of equalising the work expended, and it seemed a pity that this energy and ingenuity had not been devoted also to mechanically-driven machines. All types of jar-ram machines consisted simply of mechanical means for lifting a moulding box filled with sand, and allowing it to drop quickly by gravity, thereby solidifying the sand. This sounded very simple, but a number of important problems arise if this was to be done efficiently and economically under foundry working conditions. In the Britannia jar-ram machine air was admitted into the cylinder, and raised the table to which was attached the moulding box filled with sand. At a pre-determined point in this movement the air was automatically cut off by a reciprocating piston valve attached to the table. Although all air was now cut off and the exhaust was very slightly open, the table continued to rise, on account of the expansion of the air already inside the cylinder, till equilibrium was produced. The air then escaped through the exhaust and allowed the table to fall on to the anvil. For the best ramming results this anvil should be absolutely rigid and immovable, but with heavy moulding boxes some cushioning effect had to be introduced to modify the shock. In the Britannia machine the cushioning was effected automatically by the air held in the cylinder when the exhaust valve was closed, and by a soft steel ring in the bottom. If the ring was built up in 1-16th inch plates, the films of air between them would further absorb the shock, but with a reduction of the jarring efficiency. For larger machines other means were adopted, such as a rising anvil, springs or rubber pads. In this machine the pattern-drawing stools were attached to an annular piston. The cylinder in which the piston worked encircled the jarring cylinder. The lecturer gave diagrams showing the air expansion under different loads, and also the shock-reducing compression, which are shown in Figs. 1 to 3. He pointed out that a small instrument—a Richards steam-engine indicator—was provided to ascertain what pressure was reached inside the cylinder, and how it was maintained, and at what point and pressure the air was cut off. From the diagram thus obtained one could calculate the quantity of air used by the machine for each stroke, and judge whether the air was being used economically. By this means they knew what was going on inside the cylinder when the machine was loaded with different weights of patterns, moulding boxes, etc., with the same valve setting in every case. Illustrations were given of different patterns of Britannia and other machines, which are reproduced in Figs. 4 to 7. Anything that retarded the speed of the falling-table reduced the efficiency, and might result in soft-rammed moulds. Therefore the user should see that oil was applied twice weekly through the air-cock, and be sure that it got into both the jarring and the pattern-drawing cylinders. The machine should be cleaned down every night, particular attention being given to the guide rod, which should afterwards be oiled or rubbed with dry plumbago. A drain cock should be put in the air piping leading to each machine, and the water due to condensation should be let out regularly to prevent it getting into the cylinders and causing rust. The speed of the falling table at the point of contact with the anvil could be increased by increasing the length of jar. This could be done by raising the nut on the top of the valve spindle. The bottom nut should not be interfered with, and there should always be a clearance of at least 1-16th inch between crossbar and bottom nuts, otherwise the bottom of the valve might take the impact instead of the anvil. If the compressors were comparatively small and could not maintain a uniform air pressure for the number of machines in use, the pipes leading to the moulding machines from the compressor house should be examined for leakage. Then, if jarring was still unsatisfactory, the valves should be taken off and cleaned, not forgetting the piston displacement air-groove down the back. If the moulds broke or did not draw from the pattern properly, the moulding box should be bolted or cottered to the table during jarring. This would prevent rebound or spring in the machine table or moulding box. It was absolutely impossible to get rid of this spring, even when the table was supported over the whole of its area. Should sand or anything else get into one particular place it would defeat the object to be achieved. Perhaps the best means of reducing this spring on large moulding tables was that adopted on the Macdonald Ajax machines. In these the table had column supports, and in each of these columns was a steel anvil with a rubber pad. However small the spring might be in a machine table or moulding box, the two springs did not synchronise or spring to the same amount. The real remedy therefore was to bolt the two together and make them act as one unit. There should be a vibrator on the pattern plate. Another necessary caution was "Do not jar too long." The moulding sands should be fairly dry when narrow walls of sand were to be rammed, as in motor-cycle air-cooled cylinders. This would give a better flow. With regard to air supply, it would be well to remember also that the larger the air receiver within certain limits the larger the number of machines that could be worked from one compressor. It was important to stop the smallest leakage in the pipe-system. A ¼-inch diameter round hole would allow air at 100 lbs. pressure to escape at the rate of 100 cubic feet per minute, and 20 horse-power

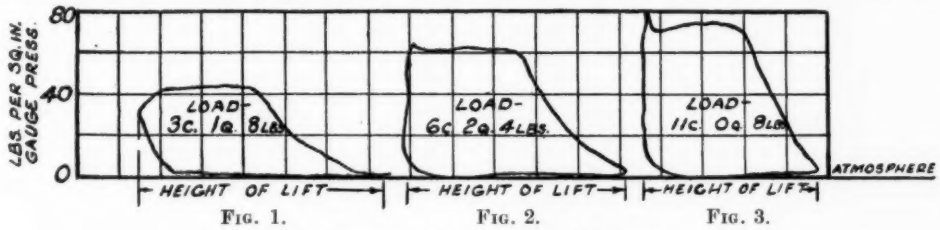


FIG. 1. FIG. 2. FIG. 3.

TAKEN FROM A NO. 1 BRITANNIA MACHINE.

would be required to enable the compressor to cope with this leakage. All pipes should be above the floor, so that any air leakage should readily manifest itself.

Very few people, even those who were using jar-ramming machines successfully, realised the immense possibilities of these appliances. It had been repeatedly demonstrated that where pattern and moulding boxes were suitably made some types of moulds when jar-rammed took little over one minute for ramming and drawing the pattern. Of course, a man could not keep up this rate of production, but with proper mechanical appliances for bringing sand and moulding boxes to the machine, and taking away the finished moulds, it was possible to produce 400 moulds in eight hours at one machine, with less physical exertion to the operator than was expended in some foundries in producing fifty moulds a day. To obtain increased output in a foundry the remedy was not necessarily additional moulding machines nor even to endeavour to make the operator work harder. In the best of British foundries, the possibilities of mechanical-carrying appliances had been seriously neglected. There were far too many hand riddles, shovels, trowels, and hand rammers, and far too much conveyance of moulding boxes by hand. There were also too many hand hammers and chisels in their dressing shops.

Having pointed out that the maximum capacity of the machines he had illustrated so far was 30 cwt., the lecturer said that he would show some really large machines of British manufacture. The Ajax No. 24 jarring and pattern-drawing turnover machine, shown in Fig. 8, was constructed with

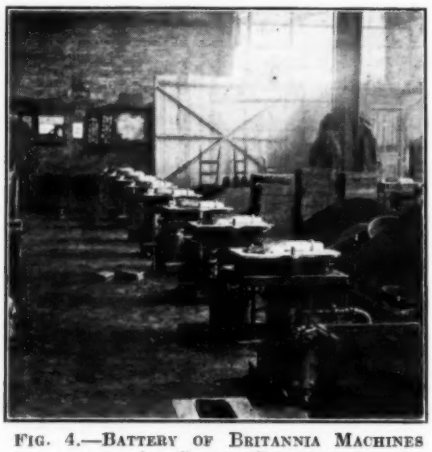


Fig. 4.—Battery of Britannia Machines with Air-Cooled Cylinders.

characteristic British solidity and reliability. The inventor, Mr. Neasham, had produced here a heavy service machine at least equal, in the lecturer's opinion, to anything made either in America or in Germany. The maximum pattern lift was 28 inches, and the jarring cylinder had a diameter of 24 inches. In one foundry this machine was making eight complete moulds per day, drags weighing 4½ tons, cope weighing 2½ tons, with four operations. Before its installation 32 men were required to do the same work, additional patterns having also to be provided.

The next machine illustrated was a 24-in. cylinder plain jar machine, without pattern-drawing and turnover appliances. The largest machine similar in construction to the one shown in Fig. 9, had a table 14 ft. long by 7 ft. wide, and was perhaps the largest jar-ram machine in this country. A special machine of the same make was designed for textile work. The lecturer added that he would have liked to show them slides of a new electrically-driven machine recently put on the market by the "Pneulec" Machine Company, of Smethwick, but unfortunately he had not had time to get them. The machine appeared to him to be of very good workmanlike design and construction.

After seeing illustration of jar-ramming machines and hearing what could be done with them it almost seemed an insult to ask a skilled moulder to spend a whole day ramming sand into a large moulding box, when the same work could be accomplished in a few minutes by mechanical means. Yet they found this mentally deteriorating influence at work in most of their foundries. Sometimes the proprietors were responsible; sometimes the moulders themselves. They heard much

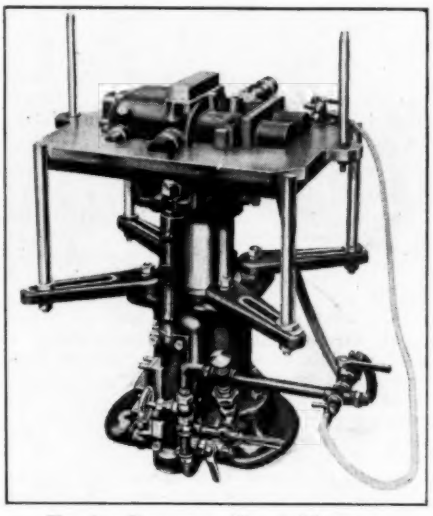


Fig 5.—Britannia No. 0 Machine.

about our men not working so hard as Continental workers and the consequent high prices of castings resulting in bad trade. Whilst the individual moulder no doubt could do something to remedy this, the greatest possibilities lay in better equipment of foundries, not only from the moulding standpoint, but also wherever labour could be cut out by the application of mechanical means. The moulder and everyone else inside the foundry should be given more scope for brain power and less for muscle. A man, even the strongest, was a very inefficient power unit, but as a directing and thinking unit his possibilities were almost infinite.

In conclusion, Mr. Wardle said that he made no excuse whatever for showing only British-made machines. One had only to think of such men as Faraday, Watt, Stephenson, and Henry Bessemer to realise that Britain was the birthplace of the modern engineering and iron industry of the world.

Discussion:

Mr. H. L. Reason, in proposing a vote of thanks to Mr. Wardle and Mr. Heggie for their Papers, said that they were fortunate in having in their Branch gentlemen who were experts each in an important line of foundry work. In Mr. Wardle they had an expert on moulding machines, and one to whom they owed an important invention in that line. He understood that the Americans took their ideas from Mr. Wardle to a certain extent.

Fig. 6.—Britannia Baby Core-making Machine.

Then, Mr. Wardle's Paper had been followed by one from a gentleman whom they all knew as an expert in pattern making. When Mr. Wardle showed them how a mould for an exceedingly complicated cylinder could be made in five minutes it struck the speaker that although their predecessors in the foundry did some wonderful work with the

tools at their disposal there was nothing like that produced in former days. It seemed to him almost the culminating point in foundry work. If Britishers could build a machine that would work like that they had no need to decry their mechanical efficiency or to go to America or Ger-

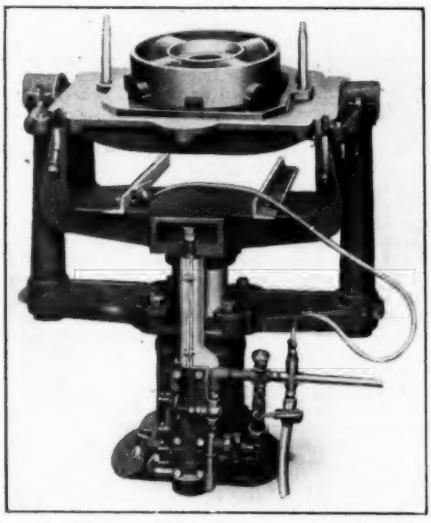


FIG. 7.—BRITANNIA NO. 0 TURNOVER MACHINE.

many. If they would only put their shoulders to the wheel as they did in the war they ought to have no difficulty in keeping Britain in the forefront. He agreed with Mr. Wardle as to the neglect of labour-saving appliances in the foundry.

MR. H. FIELD seconded the vote of thanks, which was carried with acclamation.

MR. BAGNALL JOHNSON, continuing the discussion, said that one thing that had struck him was that the maker of a moulding machine would find it in his own interest and also to the advantage of his customer if when he sold a machine he sent round an expert to explain to the buyer its capabilities. When one bought a machine there were many things about it which had to be found out, and one might be working for weeks or even months on the wrong track. Where a maker did send a man to give advice, a good many difficulties were smoothed out. He knew foundrymen in the Black Country who installed jar-ramming machines and never used them, but sold them almost immediately. The use of such machines appeared to him to be limited. One might be bought for a particular job, and if they had thousands of one thing to make it was a good thing, but it might not pay to have one where only small quantities were turned out.

MR. FLAVELL said he had worked with Mr. Wardle in connection with moulding machines for

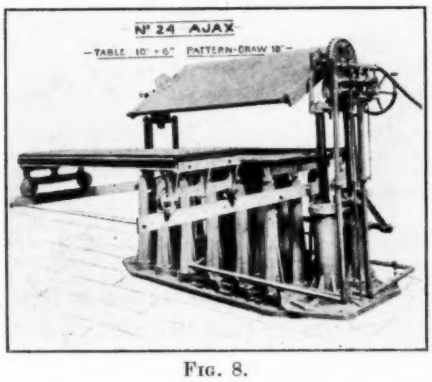


FIG. 8.

some years, and he knew the labour and thought that Mr. Wardle had bestowed upon those machines. Mr. Wardle had made moulds which he (Mr. Flavell) would have thought to be impossible by mechanical means.

MR. BUTLER said that in the foundry with which he was connected six jarring machines of the type Mr. Wardle had described had been put down in eighteen months, and they were giving the best results. It was important that the machines should be cleaned once a day. The sand if allowed to accumulate tended to wear away the inner cylinder of the annular cylinder. If one did not take heed to such things the machine would have to be scrapped in six months.

MR. TYSON said that in his opinion most of the British moulding machines were built too high. This caused a good deal of trouble in lifting and also in throwing the sand into the moulding boxes. He had seen a good many American machines which were built much lower. Neither Mr. Wardle nor Mr. Heggie referred to vibrators on moulding machines. He had seen vibrators attached to pattern plates very successfully when there had been a big draw. Another good idea he had seen carried out was to have a wooden stand attached to the wall and the vibrators fixed on the stand instead of being attached to the pattern plate.

MR. S. ROGERS asked whether it was not usual when a machine stood high to lower it into the floor a little. He was in a foundry in Scotland where they were making castings up to four tons, condensers and large pumps for marine engineering, and all the patterns were level with the floor.

MR. SUTTON asked whether the continual blows of the machine had not a tendency to warp the plates. If Mr. Wardle had any complaints of that kind perhaps he could tell them the remedy.

MR. WARDLE, in reply, said that he believed that what Mr. Johnson had stated was quite true. He agreed that some of the makers of moulding machines did not give sufficient attention to the people who bought the machines. As to Mr. Johnson's remark that one must have thousands of one article to make in order to use jar rammers successfully, he would reply that in the foundry

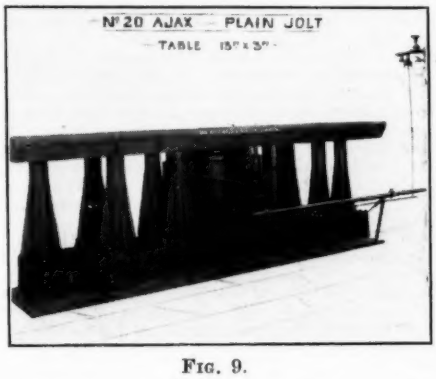


FIG. 9.

that he was connected with they used jar-ramming machines for quantities as low as six. They did not spend money on elaborate pattern plates for these small jobs, but used wood. The great advantage of using the machines was that they eliminated the "donkey work." They believed that a foundryman should not be regarded as a power unit, but that he should be a thinking unit. With regard to Mr. Butler's remarks as to the leaking, the machines referred to were of an earlier type, and in the machines since made that had been remedied. In the machine he showed on the screen it was impossible for what Mr. Butler spoke of to happen. As far as he knew the American machines were quite as high as the British. In any case, it was just a matter of letting the machine into the floor sufficiently. He knew of one Britannia machine that was let into the floor so that the top only came about 2 in. above the surface, and it was quite possible to sink any Britannia machine to the floor level.

A member asked whether that was possible with the Ajax machine.

MR. A. WARDLE said that the Ajax machine could, he thought, be brought down to floor level, but he had certainly seen them working 18 in. above floor level. He agreed that, as far as possible, lifting should be eliminated from foundry work. With regard to the bending of the pattern plates by the continual jarring, these plates were bound to wear, but the remedy for that was to fasten the plates down to the resistance box or the supporting box, so that it would not be subject to any vibration.

XUM

Trade Talk.

Last week the Barrow hoop works were re-opened for a short run.

Baldwins, Limited, propose to make an issue of £2,250,000 7½ per cent. mortgage debenture stock.

The boat-building and engineering works of Harker, Limited, of Stockton-on-Tees, have been practically destroyed by fire.

Hope Foundry, the Lawson branch of the firm of Fairbairn, Lawson, Combe, Barbour, Limited, of Leeds, has been temporarily closed.

Copper miners at Wallaroo, South Australia, have agreed to a temporary reduction of wages, and it is now hoped that the mines will re-open shortly.

The number of unemployed at Scunthorpe and Frodingham have been increased to over 7,000, owing to the closing down of the Frodingham Iron and Steel Works.

Barimar, Limited, have established a branch factory in Roumania under the style of Barimar Sociatate Anonima of Bulevardul I.C., Bratinau 24, Bucharest.

Sir William Arrol & Company, Limited, have secured an order from the Paisley Town Council for the erection of a new bridge over the River Cart. The amount of the tender is £67,500.

In the Furness iron ore mining industry there has been a reduction in wages on the latest ascertainment. The rate per shift for June will be 14s. 2d., as compared with 22s. 8d. during the whole of last year.

It is reported at Liverpool that the electricians employed in the shipyards and shipbuilding establishments, recently on strike, have returned to work, upon instructions received from the National Executive.

Mr. J. B. G. Northcott, district manager of the Electrical Apparatus Company, Limited, incorporating Bray, Markham & Reiss, Limited, has removed to Westminster Buildings, Theatre Square, Nottingham.

Licences under the Non-Ferrous Metal Industry Act, 1918, have been granted to Ashby Gihl & Company, Limited, 57, Gracechurch Street, E.C.3, and Richfield & Leigh, Limited, 224, High Street, Stratford, E.15.

Messrs. Lysaghts are inviting unmarried workmen in their employ at Newport to emigrate to the new works of the firm in Australia. The first batch of workmen, who went out some months ago, took their wives and families with them.

The volume of steel shipbuilding in the States had shrunk to 1,123,176 gross tons on May 1, according to the American Bureau of Shipping. Thirty-six ships, of 302,788 gross tons, remain to be completed for the account of the Shipping Board.

The distress among Cornish miners has become so acute that the Prince of Wales has sent £300, and the London Cornish Association has opened an account on the miners' behalf, and has decided to issue an appeal to similar Associations all over the world.

The wages of the Cumberland and Lancashire blast-furnacemen are reduced from May 2 to 215 per cent. above the standard—a drop of 60 per cent.—as the result of the fall in the average price of West Coast hematite pig-iron for the four months ended April.

Sir Sarupchand Hakumchand & Company, have placed an order with Mr. Victor Stobie, Sheffield, for two 30-cwt. electric furnaces to be installed in their new foundry at Calcutta. This, it is interesting to note, will constitute the first installation of electric furnaces in India.

Salterns, Limited, Salterns Works, Parkstone, Dorset, have concluded an arrangement with Mr. P. Pitman, lately of 25, Victoria Street, S.W.1, by which they will in future undertake the manufacture and sale of power generating water turbines of all descriptions and their accessories.

The Treasury announces that in respect of goods imported on and after May 13, 1921, the proportion of the value of German goods to be paid to the Commissioners of Customs and Excise under the German Reparation (Recovery) Act, 1921, will be reduced from 50 per cent. to 26 per cent.

At a meeting of the Royal Statistical Society last week, the president (Sir Henry Rew) announced that he had received a communication from Sir Lionel Halsey stating that the Prince of Wales had very much pleasure in complying with the Society's request to become its honorary president.

The National Light Castings Ironfounders' Federation have made application to the joint committee of the Light Metal Trades Unions for a reduction of 6s. and of 15 per cent. piece men, to take effect on June 1; and of 12½ per cent. day men and of 7½ per cent. piece men, from July 1.

As a means of furthering the ferro-concrete branch of the German shipbuilding industry a syndicate has recently been formed, known as the Concrete Shipbuilders' Union (Verein der Beton-Schiffs-Werften). The main dockyards and concrete shipbuilding yards in Germany and Austria have joined this syndicate.

The Hon. Lady Parsons presided at the general meeting of the Women's Engineering Society, held recently in London. The report stated that the industrial upheavals and consequent depression in trade had not been particularly favourable to the efforts of women to gain a firmer foothold in the engineering world.

The Council of the Royal Aeronautical Society announces an offer from an anonymous donor of an annual prize to the value of £5 for the best paper prepared by a student member of the society initiating discussion at a students' meeting during each year. This prize will be known as the "Pilcher Memorial Prize for Students" in memory of the late Mr. P. S Pilcher.

A proposal will be submitted at the special general meeting of the Institution of Electrical Engineers, to be held in London this week, that the Institution should petition the Privy Council for a charter of incorporation. The object of one clause in the charter is to confer upon corporate members of the Institution the right to use the designation "Chartered Electrical Engineer."

The annual meeting of the Birmingham Metallurgical Society was held on May 19, Mr. A. Spittle, president, in the chair. The report, which was adopted, reviewed the activities of the Society during the year. The membership of 845 showed an increase of 15. Mr. F. Johnson was elected president. Mr. L. Aitchison gave an address on "Facts and Fallacies about Case-Hardening."

One of the largest orders for road bridge construction yet placed by the South African Public Works Department has been successfully tendered for by Messrs. Ash Bros., of Johannesburg, agents for the Cleveland Bridge and Engineering Company, Limited, over a large number of American and Continental competitors. The work consists of 17 river bridges in various parts of the Union.

In consequence of representations made by the Federation of British Industries to the New Zealand Government that in the proposed revision of the Customs Tariff British goods be accorded a continuance of the preferential treatment at present in operation, the Prime Minister of New Zealand states that when the new tariff is being framed the interests of British industries will not be overlooked.

The directors of Nobel Industries, Limited, have now received from their constituent companies sufficient particulars of the trading results for 1920 to indicate that the profits will not be less than those of the preceding year. In view of the serious position in the coal-mining industry, however, they do not propose to recommend the payment of any dividend on the ordinary shares, but to carry forward the whole available balance of profit to the year 1921.

It is announced that by arrangement with United Water Softeners, Limited, Mr. J. J. Lassen has taken over the meter department of that company, and has formed the same into a separate concern under the style of the Lassen Meter & Engineering Company, Holders Hill House, Hendon, London, N.W.4. The latter company is specialising in the manufacture of the Rheograph water flow recorder and Lassen patent tipper meter for use in connection with boiler installations.

The cost of living figures for the month of April necessitate the following reductions in brass trade wages, which came into operation on the pay day in the week commencing May 23:—For men of 21 years of age and upwards a further reduction of ½d. per hour, or 1s. 11½d. per week of 47 hours. The total reduction applying now is 1½d. per hour or 5s. 10½d. per week of 47 hours. For youths 18 to 21 years of age a further reduction of ¾d. per hour, or 1s. 6d. per week of 47 hours.

An appeal is being made to members to consider the claims of the benevolent fund of the Institution of Electrical Engineers. The fund was founded over 30 years ago, and up to the present has accumulated a little over £8,000. The revenue from this sum is about £310, and the normal donations and subscriptions amount to about £500 a year. Mr. E. M. Hughman, the honorary secretary of the Calcutta Local Centre, has offered a donation of £250, provided 19 donations of a similar amount are received by June 30, 1921.

At Dudley County Court last week, the application of creditors for the winding-up of the firm of Thomas and Isaac Bradley, Limited, Capponfield Furnaces, Bilston, was heard. Counsel stated that the petitioning creditors obtained judgment for £1,113 for goods sold. Debentures were held by the company's bankers of the value of £25,000 in respect of an overdraft of £20,000. He also supported the petition on behalf of the executors of a deceased creditor for £785. Counsel for the company said a meeting of the creditors had been called for June 7, when a statement of affairs would be placed in front of them. The application was therefore adjourned.

Company News.

Blyth Shipbuilding & Dry Docks Company, Limited.—Interim dividend of 9d. per share.

Wolfram Mining & Smelting Company, Limited.—The accounts for the year ended September 30 show a loss of £25,329.

Electric Construction Company, Limited.—Dividend, 9 per cent. per annum, making 7½ per cent. for year; bonus, 2½ per cent., less tax, for year.

South Durham Steel & Iron Company, Limited. — Full half-year's dividend on 6 per cent. preference; consideration of interim on ordinary postponed.

Pease & Partners, Limited.—Final dividend recommended on ordinary of 6½ per cent., free of tax, making dividend for year at rate of 14 per cent.
Interim dividend of 2½ per cent., less income tax, for

North Lonsdale Iron & Steel, Company, Limited. — half-year ending April 30, 1921, on fully paid-up capital.

Anderston Foundry, Limited.—Disposable balance, £40,065; final dividend of 15s. per share, making 18s. per share for year, less tax; £10,000 to reserve fund; carrying forward, £11,165.

Port Talbot Graving Dock & Shipbuilding Company, Limited. — Report for year ended March 31 shows profit of £11,061. Final dividend recommended of 7½ per cent., free of tax, on ordinary.

Whitehaven Hematite Iron & Steel Company, Limited.—The directors have declared a final dividend of 6½ per cent. on the ordinary shares, making, with the interim dividend of 3½ per cent. already paid, a total of 10 per cent. for the year, free of tax.

Middlesbrough Ship Repairing Company, Limited.—Capital £5,000 in £1 shares, to carry on the business of ship repairers, owners, engineers, founders, etc. The first directors are: H. C. Pendleton and F. M. Maling, D.S.O. Registered office: Transport House, Bridge Street, Middlesbrough.

Lancashire Dynamo & Motor Company, Limited.—Net profits for 1920 were £26,493, and £5,542 was brought forward. A final dividend of 6¼ per cent. is proposed on the ordinary shares, making 10 per cent., free of income tax, for the year, reserving £10,000 for investments, and carrying forward £2,444.

Park Gate Iron & Steel Company, Limited. — Profit £122,542; add £11,532 brought in, making £134,074; deducting interim dividend paid December 1, 1920, balance disposable, £93,449. Directors recommend further dividend of 1s. per share on fully-paid shares and 3d. per share on partly-paid shares, making a total of 1s. 6d. and 4½d. per share respectively, or 7½ per cent. for year, free of income tax; carried forward, £12,199.

Personal.

MR. SUMMERS HUNTER, O.B.E., of Tynemouth, has been elected a member of Council of the Institution of Civil Engineers for the ensuing year.

MR. JOHN HILL, the general secretary of the Boilermakers' and Iron and Steel Shipbuilders' Society, has been re-elected to that position for the fourth term.

THE late Mr. John McLachlan, of Woodlands, Calside. Paisley, retired engineer and shipbuilder, who died on February 25, has left personal estate of the value of £120,967 2s. 11d.

MR. W. J. DAVIS, the general secretary of the National Brassworkers' and Metal Mechanics' Society, has announced his intention, owing to advancing years, of retiring from that position.

MR. H. LAING, of the shipbuilding firm of Sir James Laing & Sons, Limited, Sunderland, is to be presented with a handsome cup by the employés at the yard as a token of esteem and affectionate regard on the occasion of his fiftieth birthday.

MR. EDWARD LOWTHER, J.P., the general manager of the Port Talbot Railway and Dock Company, will, it is understood, shortly be leaving Port Talbot to take up an appointment under the Great Western Railway Company at Paddington.

MAJOR G. GROVE BLACKWELL, R.G.A., managing director of Compagnie des Alliages, Paris, London and Cardiff, has received the Croix de Guerre for services rendered in the defence of Ypres, 1916-1918, while in command of a siege battery, R.G.A.

MR. H. S. BOND, of Brecon, on retiring from the post of district engineer for the South Wales lines of the Midland Railway Company after nearly twenty-six years' service in that capacity, has been the recipient of a presentation from the members of his staff.

MR. EDWARD RIDER SHELDON, late of Chatsworth Square, Carlisle, engineer, a director of Cowans, Sheldon & Company, Limited, who died on June 4 last, aged 52, left £100,797, including £89,960 net personalty.

THE late Councillor Henry Brockhouse, of Lawnsiue, Hill Top, West Bromwich, director of Messrs. J. Brockhouse & Company, axle manufacturers, left £25,475, the net personalty amounting to £23,190.

Gazette.

ENFIELD MACHINE AND AUTO TOOL COMPANY, LIMITED, London, E.C., in liquidation.—Mr. E. G. Davies, 27, Clements Lane, E.C., was appointed receiver, May 6.

FARRINGDON PROPELLER AND ENGINEERING COMPANY, LIMITED, London S.W., in liquidation.—Mr. L. W. Millar, 10, Coleman Street, E.C., was appointed receiver, May 10

MIDDLESEX ENGINEERING COMPANY, LIMITED, Hounslow, in liquidation.—Mr. W. G. Blakemore, 9, King's Bench Walk, Temple, C.A., has been appointed receiver, May 7.

MIDLAND IRON AND BRASS FOUNDRY COMPANY (NORTHAMPTON), LIMITED.—It was resolved May 11:—That the company be wound up voluntarily. Mr. A. C. Towers, Arcade Chambers, Northampton, was appointed liquidator.

KING'S PARK ENGINEERING COMPANY, LIMITED.—It was resolved April 19, confirmed May 6:—That the company be wound up voluntarily. Mr. R. Denholm, Coatbridge, solicitor, is appointed liquidator. Note.—All creditors will be paid in full.

THE WESTERN COUNTIES BASIC SLAG COMPANY.—The partnership between Messrs. Thos. Humphreys Jones, Ellis Owen Roberts, Thos. Samuel Roberts, Richard Owen Roberts, and Rees Jones (trading as), 10, Dale Street, Liverpool, basic slag grinders, has been dissolved. Debts by T. H. Jones, E. O. Roberts, T. S. Roberts, and R. O. Roberts, who continue the business.

MESSRS. WALTER FREDK. SLADE. Edgar Noel Grafton, and Richard Wm. Tyrone Dobson, practising under the style of Slade, Dobson & Company, 22, Elmbank Street, Glasgow, consulting and contracting engineers, have dissolved partnership. Debts by W. F. Slade and E. N. Grafton, who continue the business as Slade, Grafton & Company, at same address.

UNDER a compulsory winding-up order made against the Tibbington Steel Sheet Company, Limited, Great Bridge Rolling Mills, Tipton, accounts have been lodged showing unsecured creditors £4,863; liabilities in respect of damages for breach of contract, £21,079 (not expected to rank for dividend); assets valued at £15,361; a surplus of £10,497 in assets over liabilities; and a deficiency of £6,154 with regard to contributories.

Deaths.

THE death is reported, on the 19th ult., of Mr. Wylie Garth, aged 72 years, for over 30 years with Messrs. Rennie's Steel Castings, Tollcross.

THE death took place recently of Mr. James Phillips, of "Glenafton," Tredegar, who for many years was the assistant chief electrician to the Tredegar Iron and Coal Company.

MR. H. FRENCH, SEN., whose death has occurred in his 83rd year, at his residence in Thornhill Terrace, Sunderland, was the head of the firm of Messrs. G. Lamb & Sons, iron merchants, Sunderland and South Shields, in which business he took an active part up to the last few weeks.

MR. WM. MILLHOUSE, Chiswick House, Cromwell Road, Scarborough, who for 40 years was water engineer at Scarborough under the Corporation, has died at the age of 72. He retired from the service of the Corporation at the end of 1919, and was retained as consulting engineer up to the time of his death.

MR. A. MONELL, the inventor of Monell metal, and president of the International Nickel Company, died recently. During the war he was a colonel in the aviation section of the American Expeditionary Forces, and his death was due, indirectly, to the high tension under which he worked during 15 months abroad. Colonel Monell was born in 1874. While connected with the Carnegie Steel Company, Mr. Monell devcloped the process of open-hearth steel making which bears his name.

The British Cast Iron Research Association.

The Council have appointed Mr. F. C. A. H. Lantsberry, M.Sc.F.I.C., as Chairman of the Research Committee dealing with the whole of the investigations and research work carried out by the Association. Mr. Lantsberry is well known in the metallurgical world, and no better appointment could have been made by the Association. It augurs well for the thoroughness with which this work will be carried out

IRON AND STEEL MARKETS.

Pig-iron.

Re-opening after the Whitsuntide recess, the Cleveland iron market was but poorly attended, and in view of the present stringency in supplies of foundry qualities, business was stagnant in the extreme. Makers, indeed, are experiencing increasing difficulty in meeting even a limited demand for foundry requirements, the stocks held on Tees-side becoming rapidly exhausted. With very little immediate prospect of furnaces restarting operations, the outlook is by no means favourable from the consumers' standpoint, so much depending on obtaining ample supplies of fuel at prices affording smelters a reasonable profit on outputs. Assuming, therefore, an immediate settlement of the miners' trouble, the earliest period at which a full supply of pig-iron can be expected must be well into the second half of the year. West Coast hematite has been reduced 20s.

Steel.

The outlook for the home steel industry at the moment can hardly be regarded as encouraging, the majority of works, for very obvious reasons, having closed down, while it is far from certain that, given more ample supplies of fuel within the near future, a general resumption of production is by any means assured. As a consequence, the only buying of steel, or its products, at present is dependent upon stock purchases, many goods in this category being disposed of at prices favourable to the consumer, but leading to the creation of an artificial standard of values which it will be impossible to maintain when conditions return to the normal. When this much desired event will materialise is, however, simply a matter for conjecture, many of the principal Sheffield firms having depleted their order books before the coal trouble started, and have since been unable to obtain fresh business owing to the world-wide slump in demand. In the meantime, foreign competition continues to gain strength, our American and Continental rivals making steady encroachment on British markets overseas.

Scrap.

Pending some settlement of the coal crisis, which, it is confidently hoped, cannot now be long delayed, business in scrap metal of all descriptions is practically non-existent, but with an early resumption of fuel supplies, there is every expectation of a smart spurt in demand for this material. Some justification for such an anticipation may be inferred from the present scarcity of foundry iron, and although it is understood that consumers generally are well stocked with scrap metal, the time that must necessarily elapse before pig-iron production can be resumed at a normal rate will encourage an increased demand from foundries. Some such idea is, at all events, reflected in the Lancashire district, where the exhaustion of the remaining stocks of pig-iron makes the market appear stronger than is actually the case.

Ore.

With all consuming interests completely idle markets for both native and imported ores are naturally at a standstill, and it is now some weeks since any transactions were recorded. Meanwhile, the position at Bilbao may be summarised as follows :—From April 12 to 26 only 20,000 tons of mineral were shipped from Bilbao as against 230,000 tons in the same period of last year. There seems to be an idea that the German question and the British strike will both be satisfactorily settled within the near future, and the mine-owners appear to hope for orders from both countries at the prices current last December. It remains to be seen whether these expectations, especially as regards prices, will be realised.

Finished Iron.

Depression in all sections of the finished iron trade continues unchecked, very few manufacturers having facilities for the execution of orders, even if the opportunity should present itself, while limited stock resources are being steadily depleted to meet current requirements. These conditions are more specially apparent in the case of South Staffordshire, where most of the finished iron works are closed.

Keep Your Furnaces

going

without Coal & Coke

by using the . . . **"EYRE"**

System of Liquid Fuel Burning

(INCORPORATING THE HOVELER PATENTS).

In Use 14 Years. *Write, 'Phone, Telegraph or Call:*

THE EYRE SMELTING CO., LTD.,

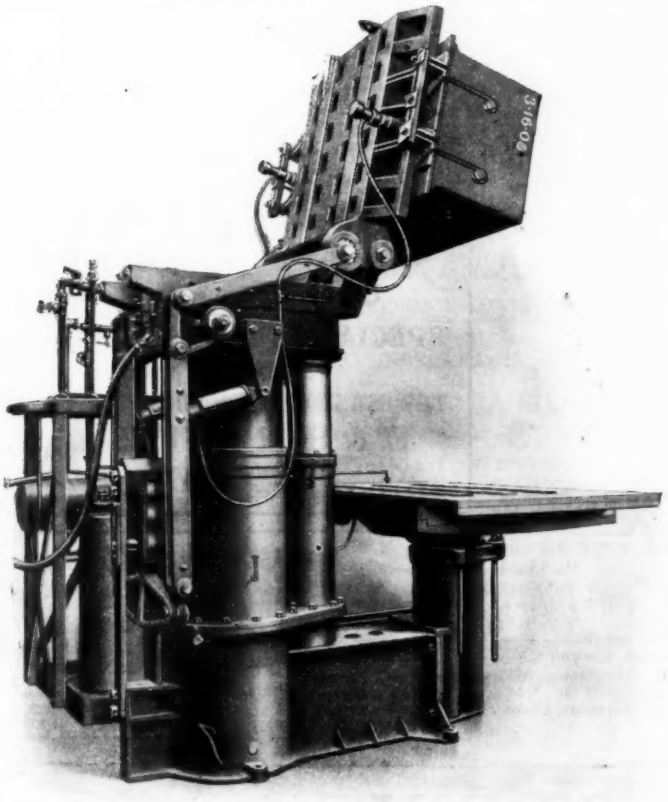
Telegrams: MERTON ABBEY, LONDON, S.W.19. Telephone:
ANALYZING, LONDON. WIMBLEDON 604 and 605.

MACNAB & CO.

TABOR PATENTS.

Patent Combination Shockless Jar Ramming Power Roll-over and Pattern Drawing Moulding Machine.

Suitable for the most economical production of any repetition work, from the smallest up to a load of 12,000 lbs. at 100 lbs. air pressure, covered by a range of five machines.



Mould having been rammed, box and pattern in act of being rolled over on to levelling table on other side of machine.

Jar rams the box in less than one minute.

Rolls the mould over, draws and raps the pattern.

Rolls the pattern back ready for the next box.

COMPLETE MECHANICAL OPERATIONS OF THE MACHINE NOT EXCEEDING FOUR MINUTES.

56/8, Eagle Street, Southampton Row, London, W.C.1.

Metals.

Copper.—This metal has declined substantially during the week. A weakening of the price of copper by large producers is also reported in America, and is proving somewhat disconcerting to the industry in face of the drastic curtailments by the big companies which have been put into effect. There seems difficulty in gauging the reason for selling at low prices around 12⅝c. a pound, as the companies offering metal are supposed to be in a good cash position. In certain quarters it is believed the view is taken that there can be little expectation of important European buying for some time to come. Apparently domestic consumption is not encouraging, and talk of surplus conditions does not appear to warrant the restarting of output by the important companies for another six months. According to advices, foreign inquiry continues to be confined mainly to English and Japanese buying. The latter is to a considerable extent on account of Japanese trading companies having close affiliations with steamship lines, and is resorted to in order to complete cargoes instead of using ballast.

Tin.—A fall of several pounds has to be reported in tin this week. Notwithstanding this, reports indicate that the prospects of the tinplate industry are more encouraging, and, among others, a fair quantity of orders emanating from Japan are accumulating. There has been a little demand for June dates on the standard market, with the result that the contango has become very small.

Spelter.—Generally speaking, this market has been weak, with consumers showing little demand, owing to the depression in the galvanised trade. There is, however, little material offering, since the appreciation in the Belgian exchange is compelling producers to ask higher prices, and Norway is still keeping out of the market.

Lead.—This metal has followed the downward course to the extent of almost £2. The falling off in imports is only temporary, and partly the result of shipping difficulties arising from lack of coal, but it nevertheless caused a freer demand for warehouse lead at one time, but this has since subsided. There is still a good deal of uncertainty in regard to future arrivals, but for the present it is generally felt that, in view of the very poor state of the consuming trades, the reactionary movement may be extended.

MISCELLANEOUS advts., see also page 20.

Large quantities BALL BEARINGS (new and second hand).
SPECIFICATION STEEL, ⅝ in. to 1¾ in.
HIGH SPEED and CARBON DRILLS, ¾ in. to 2 in. (all new).
HIGH SPEED REAMERS, 21/64 in. to ⅞ in. (all new). On view any time.
SIMOON ENGINEERING,
Bramber Road, London, W.14.

ORDERS WANTED for small Machine-made Castings in Brass, Gunmetal, Phosphor, or Manganese Bronze. Also Castings any size up to one ton in weight. Prompt delivery.—JAMES G. CROWTHER, Paradise Street Brass Foundry, Sheffield.

CASTINGS (IRON) ORDERS WANTED for any weight and size (Yorkshire District). Machined if necessary.—Address, Box 728, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

WE Specialise in Aluminium Castings, die and sand. Enquiries solicited. Prompt deliveries. Also Castings in Brass, Gunmetal and Phosphor or Manganese Bronze.—H PERKS & Co., 90, Seymour Place, W.1.

ENQUIRIES SOLICITED FOR CASTINGS IN IRON, machined or unmachined, up to 5 cwt. Complete Machines built throughout to specification, singly or in quantity. Jig and Tool Work a speciality.—C. S. PEATFIELD, LIMITED, Market Rasen, Lincs.

PATTERNS and CASTINGS SUPPLIED WHICH GIVE SATISFACTION. Inquiries solicited. Quotations by return of post or telephone. You can secure good-class work, reasonable prices, and promptitude in delivery by placing your orders with VIDEX PATTERN WORKS AND FOUNDRY, Huntsworth Mews, Upper Baker Street, London, N.W.1. (Telephone, Paddington 364).

FOR SALE, cheap, Foundry Pig Iron, all sections, F.B. Steel Rails, with all accessories; Joists, Channels, Angles, Sheets and Plates, all thicknesses; plumbago.—ASCOG, Golder's Green, London. Telephone; Hampstead, 1806.

WE Specialise in FANS and FAN WORK for Foundries. H.P. Fans and Blowers for Smiths' Hearths, Cupolas, Oil and Gas-fired Furnaces, Dust Extraction Fans for Fettling Shop and Sand Blast, Ventilating Fans for Fumes, etc. Worm-geared Pulley Blocks, 10 cwt. to 10 tons.—PROGRESSIVE ENGINEERING COMPANY, LIMITED, Leicester.

MORTAR MILL, 7 ft., over-driven, with Vertical Engine attached, absolute "tip-top" condition; low price for speedy sale.—R. B. ROGERS, contractors, 67, Temple Estate, Manchester, N.

MORTAR MILL, equal to new, 5 ft. 6 in., overdriven, fully complete, hardly used; a distinct bargain to save second removal.—R. B. ROGERS, contractor, 67, Temple Estate, Manchester, N.

PATENTS.

ADVICE and Handbook Free. — KING'S PATENT AGENCY, LIMITED, Director, B. T. King, Reg. Patent Agent, 146a, Queen Victoria Street, E.C.4.

CASTINGS

Up to 7 or 8 Cwt. each.

SPECIALITY: Machine moulding and repetition work.

LOWEST PRICES. PROMPT DELIVERIES.

E. & H. ROBERTS LTD.,

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STONEY, - - STRATFORD.

Every description of Steel Stamps made on the premises by ex-service men. 33 years' experience. Personal producer.
E. DEARMAN & SONS, 8, ELDON STREET, SHEFFIELD.

SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

SPECIAL STEEL FOR CONSTRUCTIVE PURPOSES.

The STEEL COMPANY OF SCOTLAND, Ltd.

Head Office: 23, ROYAL EXCHANGE SQUARE, GLASGOW.
Works: HALLSIDE, NEWTON and BLOCHAIRN, GLASGOW.

CONTRACTORS TO HOME, COLONIAL AND FOREIGN GOVERNMENTS.

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50 %

INCREASED OUTPUT

A CUSTOMER informs us that, using Cast Iron boxes on a run of Pinions weighing ½ cwt. each, he was getting an output of 4 castings per day per man. HE put BOYS on to the work with our LIGHT STEEL BOXES, and recorded a constant output of 6 castings per day per boy.

CORRUGATED
PRESSED STEEL
FOUNDRY FLASKS.

Made to any Size and Specification.

Designs submitted against Customers' Patterns or Drawings.

THOUSANDS IN DAILY USE.

LIGHT, RIGID, UNBREAKABLE,
and
FULLY GUARANTEED.
Write for Stock List and Prices.

PERFORATED REINFORCED PRESSED STEEL
CORE PLATES.

SHEET METAL WORK
of all Descriptions.
Black and Galvanised.

HIGH-CLASS WORK
for Engineers a Speciality.

Rivetted, Oxy-Acetylene or Electrically Welded.

SHEET METAL & GALVANIZING CO., LTD.

Spencer Road, Lidget Green, Bradford.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d
Standard cash	72	10	0
Three months	72	15	0
Electrolytic	76	0	0
Tough	73	10	0
Best selected	74	0	0
Sheets	116	0	0
India	116	0	0
Wire bars	76	5	0
Do. June	76	5	0
Do. July	76	5	0
Ingot bars	76	0	0
H.C. wire rods	82	10	0
Off. aver. cash, Apr.	69	8	11⅝
Do. 3 mths., Apr.	69	9	2⅝
Do. Settlement Apr.	69	8	6⅜
Do. Electro, Apr.	72	16	2⅜
Do. B.S., Apr.	71	6	8
Aver. spot, copper, Apr.	69	7	10¼
Do. Electro, Apr.	73	16	8
Solid drawn tubes		15½	d.
Brazed tubes		15½	d.
Wire		12	d.
Yellow metal rods		8¾	d.
Do. 4x4 Squares		10½	d.
Do. 4x3 Sheets		10½	d

BRASS.

Solid drawn tubes	13¾d.
Brazed tubes	16½d
Rods	12¾d.
Sheets to 10 w.g.	12d.
Wire	11½d.
Rolled metal	11½d.

TIN.

	£	s.	d
Standard cash	174	0	0
Three Months	175	0	0
English	171	10	0
Bars	173	10	0
Chinese	166	10	0
Straits	177	10	0
Australian	176	10	0
Eastern	184	0	0
Banca	183	19	0
Off. aver., cash, Apr.	164	0	11⅞
Do. 3 mths., Apr	166	19	4½
Do. Sttlment., Apr.	164	0	0
Aver. spot, Apr.	163	19	3½

SPELTER.

	£	s.	d
Ordinary	27	5	0
Remelted	23	10	0
Hard	16	10	0
Electro 99.9	35	15	0
English	32	0	0
India	22	10	0
Prime Western	28	15	0
Zinc dust	50	0	0
Zinc ashes	6	0	0
Off. aver., Apr.	26	1	5⅝
Aver., spot, Apr.	25	10	7

LEAD.

	£	s.	d
Soft foreign ppt	22	5	0
English	23	15	0
Off. average, Apr.	20	16	10½
Average spot, Apr.	20	11	9½

ZINC SHEETS.

	£	s.	d
Zinc sheets, spot	36	0	0
Do. V.M. ex. whf.	36	0	0
Do. ppt., f.o.b., N.Y.		—	
Dutch	36	0	0
Boiler plates	33	0	0
Battery plates	32	10	0

ANTIMONY.

	£	s.	d
English regulus	37	0	0
Special brands	42	0	0
Chinese	24	10	0
Crude	18	0	0

QUICKSILVER.

	£	s.	d
Quicksilver	11	2	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
45/50%	£16 10 0
75%	£23 10 0
Ferro-vanadium—	
35/40%	22/- lb. va.
Ferro-molybdenum—	
70/80%	8/- lb. mo.
Ferro-titanium—	
23/25%, carbonless	1/6 lb.
Ferro-phosphorus, 20/23%	£30
Ferro-tungsten—	
80/85%, carbon free	1/10 lb.
Tungsten metal powder—	
98/99%	2/3 lb.
Ferro-chrome—	
4/6% car.	£37 0
6/8% car.	£36
8/10% car.	£35 10
Ferro-chrome—	
Max. 2% car.	£84
Max. 1% car.	£100
Max. 0.75% car.	£115
65/75%, carbonless	2/9 lb.
Nickel—99·8%, cubes or pellets	£190
Cobalt metal—97%	15/- lb.
Aluminium—98/99%	£150
Metallic Chromium—	
98/99%	6/6 lb.
Ferro-manganese—	
76/80%, loose	£18
76/80%, packed	£19
76/80%, export	£18
Metallic manganese—	
98/99%, carbonless	3/- lb.
Per ton unless otherwise stated.	

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten	3	0
Finished bars, 18% tungsten	3	9
Scrap pieces	5d.	
Turnings and swarf	3d.	

Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb
Flats under 1 in. by ⅛ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness 3d. lb.
Bevels of approved sizes and sections 6d. lb.
If in coils 3d. lb.
Packing 4s. cwt
Bars cut to length 10% extra
Scrap from high-speed tool steel—
Scrap pieces 5d.
Turnings and swarf 3d.

Per lb. net, d/d steel makers' works.

SCRAP.

	£	s.	d
South Wales—£ s. d.			
Heavy Steel	3	0	0
Bundled steel & shearings	2	15	0
Mixed iron & steel 1 0 0	3	10	0
Heavy cast iron	3	15	0
Good machinery for foundries	6	0	0
Cleveland—			
Heavy steel	3	0	0
Steel turnings	2	7	6
Cast-iron borings	2	7	6
Heavy wrought iron piling	3	10	0
Bundling scrap	4	5	0
Cast-iron scrap	5	2	6
Lancashire—			
Cast iron scrap	6	0	0
Heavy wrought	3	0	0
Steel turnings	1	19	0
London—			
Copper (clean)	51	0	0
Brass (clean)	30	0	0
Lead (less usual draft)	18	10	0
Tea lead	16	10	0
Zinc	13	0	0
New aluminium cuttings	70	0	0
Braziery copper	41	0	0
Gun metal	45	0	0
Hollow pewter	135	0	0
Shaped black pewter	80	0	0

PIG-IRON.

N.-E. Coast—	
Foundry No. 1	125/-
Foundry No. 3	120/-
Forge No. 4	117/6
Mottled	117/6
Hematite No. 1	162/6
Hematite M/Nos.	160/-
Midlands—	
Staffs. common	145/-
,, part-mine forge	160/-
,, ,, foundry	170/-
,, Cold blast	320/-
,, basic	140/-
Northants forge	140/-
,, foundry No. 3	147/6
,, basic	140/-
Derbyshire forge	150/-
,, foundry No. 3	160/-
,, basic	150/-
Scotland—	
Foundry No. 1	170/-
,, No. 3	165/-
Hematite M/Nos.	180/-
Sheffield (d/d district)—	
Derby forge	155/-
,, foundry No. 3	160/-
,, basic	155/-
Lincs. forge	160/-
,, foundry No. 3	170/-
,, basic	162/6
E.C. hematite	173/-
W.C. hematite	176/-
All d/d in the district.	
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, foundry No. 3	170/-
Northants foundry No. 3	—
Cleveland foundry No. 3	—
Staffs. foundry No. 3	—
Lincs. forge	172/6
,, foundry No. 3	177/6
Summerlee foundry	193/-
Glengarnock foundry	195/6
Gartsherrie foundry	193/-
Monkland foundry	193/-

FINISHED IRON & STEEL.

Iron—	£	s.	d.
Bars (cro'n)	19	0	0
Angles	19	10	0
Tees to 3 united ins.	20	0	0
Nut and bolt	19	0	0
Hoops	23	0	0
Marked bars (Staffs.)	27	10	0
Gas strip	22	0	0
Bolts and nuts, ¾ in. × 4 in.	38	0	0
Steel—			
Ship plates	19	0	0
Boiler plates	25	0	0
Checquer plates	20	0	0
Angles	17	10	0
Tees	18	10	0
Channels	18	0	0
Joists	17	10	0
Rounds, ¾ in.–3-in.	14	0	0
Rounds, 3 in.–5½ in.	13	0	0
Flats, 5 in.–8 in.	14	10	0
Flats over 8 in.	13	0	0
Rails, heavy	15	0	0
Fishplates	20	0	0
Hoops	16	10	0
Black sheets, 24 g.	19	10	0
Galv. cor. sheets, 24 g.	22	0	0
Galv. fencing wire, 8 g. plain	23	10	0
Rivets, ¾ in. dia	27	0	0
Billets, soft	11	10	0
Billets, hard	12	10	0
Sheet and tin bars	11	10	0

PHOSPHOR BRONZE.

Rolled.	Per lb. s.	d.
½ in. to 1 in. wide	1	9½
1 in. to 1½ in. wide	1	9½
1½ in. to 2 in. wide	1	7½

Strips.	s.	d
2 in. to 6 in. to 26 S.W.G.	1	7½
6 in. to 12 in. to 26 S.W.G.	1	7½

Sheets.	s.	d.
12 in. to 18 in. to 24 S.W.G.	1	7½
18 in. to 24 in. to 24 S.W.G.	1	8½
24 in. to 30 in. to 20 S.W.G.	1	9½
30 in. to 36 in. to 16 S.W.G.	1	9½
36 in. to 42 in. to 16 S.W.G.	1	10½

Extras.

For Gauge: Any width up to 36 in. wide, ½d. per lb. per thinner gauge.

Drawn Rods.	s.	d.
¼ in. to ½ in. dia. in random lengths; 5/16 in. to 1½ in. dia. in random lengths	1	7
Over 1½ in. to 1¾ in.	1	7

Tubes—basis price 1 9½
Delivery 2 cwt. free to any town.
10% phosphor copper, £40 above price of B.S.
15% phosphor copper, £50 above price of B.S.
Phosphor tin (5%), £30 above price of English ingots.

Charles Clifford & Son, Limited, Birmingham.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	1/1 to 1/7
Rolled—	
To 9 in. wide	1/8½ to 2/2½
To 12 in. wide	1/9 to 2/3
To 15 in. wide	1/10 to 2/4
To 18 in. wide	1/11 to 2/5
To 21 in. wide	2/- to 2/6
To 24 in. wide	2/1 to 2/7
Ingots for spoons and forks	1/1 to 1/7
Ingots rolled to spoon size	1/4 to 1/10
Wire round—	
3/0 to 10. G.	1/11 to 2/6

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	25.81
No. 2 foundry Valley	23.50
No. 2 foundry, Birm.	22.00
Basic	23.96
Bessemer	25.96
Malleable	25.96
Grey forge	23.46
Ferro-manganese 80 % delievred	85.00
Bess. rails, h'y, at mill	45.00
O.-h. rails, h'y, at mill	47.00
Bess. billets	37.00
O.-h. billets	37.00
O.-h. sheet bars	39.00
Wire rods	48.00
	Cents.
Iron bars, Phila.	2.35
Steel bars	2.10
Tank plates	2.20
Beams, etc.	2.20
Skelp, grooved steel	2.20
Skelp, sheared steel	2.20
Steel hoops	2.75
Sheets, black, No. 28	4.00
Sheets, galv., No. 28	5.00
Sheets, blue an'l'd, 9&10	3.10
Wire nails	3.00
Plain wire	3.00
Barbed wire, galv.	4.10
Tinplate, 100-lb. box	$6.25

COKE.

Welsh foundry	67/6
,, furnace	55/-
Durham & North. foundry	70/-
,, furnace	42/6
Other Districts, foundry	77/9
,, furnace	45/-

SWEDISH IRON.

Bars, hammered basis sizes. Basis price £31 to £32

Rolled Ordinary—Assortment .. £22 10 0 to £23 10 0

Nail Rods—Square, round and flats .. £22 10 0 to £23 10 0

Keg Steel .. £38 to £40

Faggot Steel .. £30 to £32

Blooms—Single welded .. £16 to £18

Billets—Single and double welded .. £18 to £23

Pig-Iron—Grey, white or mottled .. £12/10 to £14

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

TUBES.

	Up to and incl. 2 in.	Over 2 in.
Gas ..	−15%	−20%
Water ..	− 5%	−11¼%
Steam ..	+ 6¼%	− 1¼%

TINPLATES.

I.C. Cokes,	20×14, box	26/-
,,	28×20, ,,	53/-
,,	20×10, ,,	37/-
,,	18¾×14, ,,	30/-
I.X.	,,	68/-
I.X.X.	,,	88/-
F.C.B.Y.	21×13⅝ ,,	50/6
C.V.B.G.	16½×15, ,,	50/-
I.C.W.	20×14, ,,	21/6
,,	28×20, ,,	40/-
,,	20×10, ,,	29/-
,,	18¾×14, ,,	20/-
Terneplates,	28×20, ,,	53/-

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
May25	74	15	0	inc.	15/-
,, 26	74	10	0	dec.	5/-
,, 27	73	17	6	,,	12/6
,, 30	73	0	0	,,	17/6
June 1	72	10	0	,,	10/-

Electrolytic Copper

May25	76	0	0	No change
,, 26	76	0	0	,,
,, 27	76	0	0	,,
,, 30	76	0	0	,,
June 1	76	0	0	,,

Standard Tin (cash).

May25	182	0	0	inc.	20/-
,, 26	180	15	0	dec.	25/-
,, 27	177	15	0	,,	60/-
,, 30	173	10	0	,,	85/-
June 1	174	0	0	inc.	10/-

Tin (English Ingots)

May25	179	0	0	inc.	10/-
May26	179	0	0	dec:	10/-
,, 27	175	15	0	,,	65/-
,, 30	171	10	0	,,	85/-
June 1	172	0	0	inc.	10/-

Zinc Sheets (spot).

May25	36	0	0	No change
,, 26	36	0	0	No change
,, 27	36	0	0	No change
,, 30	36	0	0	No change
June 1	36	0	0	No change

Spelter (ordinary).

May25	28	5	0	No change	
,, 26	28	0	0	dec.	5/-
,, 27	28	0	0	No change	
,, 30	27	10	0	dec.	10/-
June 1	27	5	0	,,	5/-

Lead (English).

May25	25	5	0	No change	
,, 26	25	0	0	dec.	5/-
,, 27	24	10	0	,,	10/-
,, 30	24	0	0	,,	10/-
June 1	23	15	0	,,	5/-

SHROPSHIRE IRON Co., Ltd.

Works:—
Hadley, Shropshire.

Telegrams:—
Sun, Wellington, Salop.
Sunbrand (Cannon), London.

London: 10, Bush Lane, Cannon St., E.C.4.

Telephone:—
11 Wellington, Salop.
5959 Central.

BARS, HOOPS, SECTIONS & WIRE
in IRON, STEEL, COPPER and BRONZE.

Galvanised Telegraph, Telephone, Cable and Trolley Wire
To all Specifications.

Contractors to H.M. Government (Admiralty, G.P.O., India Office, War Office, Colonies), English and Foreign Railways, &c.

BEST H. C. COPPER & BRONZE WIRE a speciality.

Medals:—Sydney (Bronze) 1879, New Zealand (Gold) 1882, Liverpool (Silver) 1886, Adelaide (Gold) 1887, Franco-British Grand Prix (Highest Award) 1908.

ROBERT HEATH & LOW MOOR, LIMITED,
Stoke-on-Trent.

B.B.H. IRON.
At works.
BARS, ANGLES, TEES and PLATES.

R.H. ✠ IRON.
Delivered F.O.B. Liverpool.
BARS, ANGLES, TEES and PLATES.

HOOPS delivered F.O.B. Liverpool.

IRON
R.D. ✠
RAVENSDALE (Best)

MILD STEEL (up to 2in. wide)
Marked
"HEATH'S SOFT STEEL."

Prices on Application.

WILLIAM JACKS & COMPANY,
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Telegrams: ALKALIZE, BIRMINGHAM.
Telephone: CENTRAL 1175 & 1176
Birmingham Office:
18, BENNETT'S HILL.

Telegrams: ALKALIZE, LONDON.
Telephone: 7880 AVENUE (3 lines.
Head Office:
5, EAST INDIA AVENUE, London, E.C.

REGISTERED TRADE MARK
LIMPET

PIG IRON.

Scotch, Middlesbro,' Hematite, Basic, Specials, &c., &c.

TIN — SPELTER — CHROME
COPPER — ANTIMONY—MANGANESE.

WILLIAM COLVIN & COMPANY,

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FOREMAN BRASS-MOULDER desires change. Thorough practical man. Experienced in Gun Metal, Phosphor Bronze, Mang., Bronze and Aluminium. Strict disciplinarian and timekeeper.—Apply Box 760, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

MOULDER, Brass and Aluminium, small and medium, fine and common; 25 years' experience London and Provinces; arrangement or charge hand.—Apply Box 756, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

BRASS FOUNDRY FOREMAN required. Applicants must be accustomed to controlling men, and be capable of getting the maximum output at a minimum of cost.—Apply, in confidence, stating age and experience, to Box 754, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

TENDERS.

MIDLAND GREAT WESTERN RAILWAY OF IRELAND COMPANY.

SECOND-HAND RAILS AND SCRAP FASTENINGS FOR SALE.

The Directors of the above Company are prepared to receive Tenders for the sale of the following, which will be available for delivery on or about the 1st August next :—

Approximately 3,300 tons re-usable flat-bottomed Steel Rails and Fishplates (original weight of rails 80 lbs. per yard, average weight now about 75 to 76 lbs. per yard).

Approximately 900 tons Scrap Stel Rails (original weight 80 lbs. per yard, now about 70 to 72 lbs. per yard).

Approximately 700 tons Scrap Railway Fastenings and short Rail Cuttings.

All the material to be loaded, weighed and removed by the Purchaser from the Company's Yard at Newcomen Junction, Dublin, at his sole expense.

Samples can be inspected on application to the Storekeeper, Broadstone Station, Dublin.

Tenders to be forwarded so as to reach the undersigned not later than Friday, June 24, 1921.

The Directors do not bind themselves to accept the highest or any Tender.

PERCY A. HAY,
Secretary.

Broadstone Station, Dublin.
26th May, 1921.

MACHINERY.

PLANING MACHINE, second-hand, required to plane 6 ft.—J. DAVIS, 64, Victoria Street, Westminster.

FOR SALE.

13 Sets of Diesel OIL ENGINES, 200/250 h.p., 320/420 revs.

Vertical Boring and Turning MILL, with 57-in. Table, with two tool boxes on cross slide, by the Bullard Machine Tool Company.

Vertical Boring and Turning MILL, with 50-in. Table, with two tool boxes on cross slide, by the Bridgeport Machine Tool Works.

Three nearly new No. 3 Kempsmith Universal MILLING MACHINES, with equipment.

Horizontal Duplex Boiler Feed Pump, about 4½ in. x 3 in. x 4 in., with G.M. valve boxes, by H. Watson & Sons.

Double Ram Cameron Type PUMP, two steam cyls., 17 in. diam. by 15 in. stroke, rams 11 in. diam.

Seven Double Cameron Type PUMPS, pair of 8½ in. cyls., 6 in. rams, 8 in. stroke.

Eleven Vertical Weir PUMPS, 11 in. steam cyl., 7½ in. water, 7½ in. stroke, G.M. valve boxes.

Set of Powerful Three-Throw HYDRAULIC PUMPS, 4¾ in. rams, 15 in. stroke, by Hawthorn, Davey & Company, Limited.

Set of Nearly New Horizontal Three-Throw HYDRAULIC PUMPS, for motor drive (no motor), 3½ in. cyls., by Davy Bros., Limited.

CATALOGUE of STOCK MACHINERY, 5-600 Lots Free on Application. Inspection Invited.

THOS. W. WARD, Albion Works, SHEFFIELD.
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HALL'S Invincible Sand Mixer, capacity 1 ton per hour, 18 in. dia., equal to new, suitable for mixing and preparing all kinds of foundry sands at the lowest cost per ton.—Apply, C .E. V. HALL, 26, Paradise Square, Sheffield.

FOR SALE.—New and Second-hand Foundry Plant. 50 Pairs Steel Moulding Boxes, 16 in. x 14 in. x 6 in.; centre of holes 19 in. Two Adaptable Moulding Machines. Two 1-ton Morris Elevating Trucks. One Tilghman's Sand Blast Plant, with Compressor.—Address, Box 744, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

"ABRAHAM" PORTABLE MOULDING MACHINES,
Fitted with Turnover Attachment.
save 50 per cent. on labour. A boy can make 120 good moulds per day. The unskilled operator cannot help getting a perfect draw. Price £25. Send for list.

DINGLEY PARSONS & CO.,
Guildhall Buildings, Navigation Street, Birmingham.

You save money by buying from us!
Lancashire Boiler, 30 ft. x 8 ft., for 120 lbs. w.p.
Loco. Type Boiler, by Robey, 105 lbs. w.p.
5-ton Overhead Foundry Crane, 30 ft. span.,
35-h.p. Modern Crossley Gas Engine, "U" Type.
20, 30, 40 and 50-h.p. Electric Motors, 460 Vo. D.C.
Blowers, Fans, Engines, etc. Send your enquiries, HARRY H. GARDAM & COMPANY, LIMITED, Staines. 'Phone 98.

CUPOLA, New Alldays and Onions Climax Rapid, 6 ft. by 2 ft, 6 in.; two Bars of Turned Steel Shafting, 18 ft. 6 in. by 3½ in.; Valour Oil Filter; 30in. Angle Bender (Rhodes).—46, William Edward Street, Birmingham.

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ONE 400-lb. and one 300-lb. Buess Oil-fired Melting Furnaecs, first-class condition, for sale cheap.—DAVID BROWN & SONS, LTD., Lockwood, Huddersfield.

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SPECIAL OFFER. Subject to being Unsold. Best New Perfect Sheffield Files. 14-in. Hand Bastard, parallel, one safe edge; makers, John Kenyon & Company, Sheffield. 12-in. Hand Second Cut, parallel, one safe edge; makers, Camm, Bagshaw & Company, Sheffield. All at 18s. per dozen. Carriage paid on 12 dozen lots.—SMITH BROS., Aylestone Park, Leicester.

For continuation of small advertisements see page 506.